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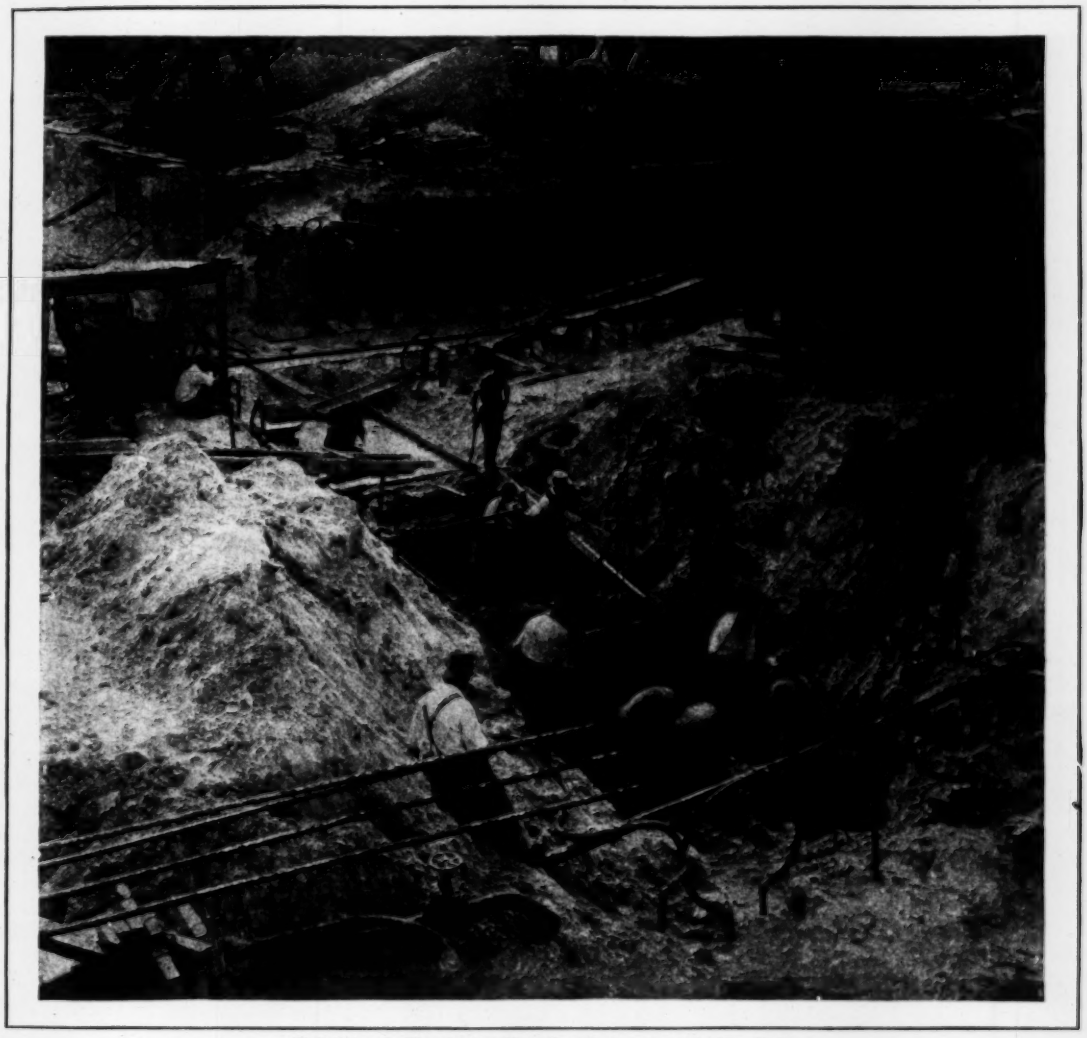

Well-Points in Ritz-Carlton Hotel Foundation, Atlantic City, N. J.

Hydraulic Excavation for Seashore Hotel Foundation

Road Survey Methods and Costs in Missouri

Belgian Standard Specifications for Structural Steel

Assuring Safety in Old Highway Bridges

By M. W. Torkelson

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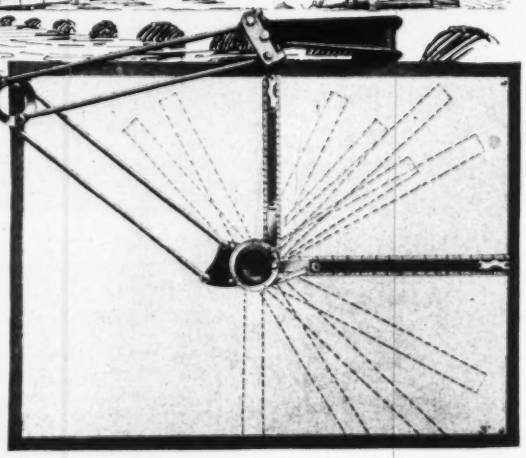

The photograph shows the drafting room of the Bridge Department of the Illinois, Central Railroad Co., Chicago, who have a full equipment of Universal Drafting Machines.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
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Engineer to Run Barge Canal

IT IS the intention of Governor Miller, of New York, to advocate a constitutional amendment which will consolidate the offices of the state engineer, superintendent of public works and the commissioner of highways. This is a logical step, comparable to the movement for a federal Department of Public Works, for the co-ordination of all the engineering work of the state. Meanwhile the governor has done all he could toward this end by appointing an engineer as superintendent of public works. The duties of this office are various, but among the most important is the operation of the Barge Canal. This is a traffic problem which has required the direction of a competent engineer for many years. So far the canal has been a dismal failure, for reasons which the various previous superintendents have not hesitated to express. Mr. Cadle, the new superintendent, now has a great opportunity to show what an engineer—and a railway engineer at that—can do with canal operation and to demonstrate what the differences are between an engineering and a lay administration of a transportation unit.

Kansas Industrial Court Decision

MUCH ado was made in the Western papers a short while ago when the flour mill owners of Topeka were haled before the Kansas Industrial Court on charges of restricting output in order to keep up price. The action was acclaimed as evidence that the court's jurisdiction would be used impartially, that it would condemn combinations of capital just as quickly as it would combinations of labor. It had been attacked in the labor world as an instrumentality for working the will of capital. The decision in the Topeka flour mills case has now been handed down, and the mills are entirely exonerated. The evidence showed that their production had been decreased because of a falling off in demand, and that it was entirely justified. The court did take occasion, however, to lay down the principle, so generally conceded that there seemed no reason for emphasizing it, that "skilled and faithful employees should be given such treatment as will enable them during the period of limited production to support themselves and families." The decision should have educational value with the agitators.

Peak Load Construction Plants

PROVISION of equipment on the theory of conducting construction in a series of peak performances between delays met successfully the problem of building the automobile body factory described on p. 82. Ordinarily peak load plants are economically unjustified. Neither can they be adapted to any considerable number of operations. To consider them otherwise than emergency measures at this time is warranted only by the fact that rail movement of construction materials has been unreliable. If train schedules are to be maintained in operations where large concentrations of material are required contractors must provide means to overcome interruptions to continuous operation because of irregular rail deliveries. Such provision can be made. The important fact to be observed, as disclosed by the article on p. 82, is that multiplication of construction equipment proper is not alone sufficient. Rail transportation must be aided directly by supplying cars, and on occasion locomotives. A task so formidable lies within the power of only very large construction organizations to accomplish. Its cost is warranted only in exceptional instances.

Parks and Water Power

ONE important amendment, removing national parks from the provisions of the water-power act, has been introduced in Congress in several wordings. This is supported by the usual hysterical nature-lover propaganda, which in its most rabid form—and in this form it has had wide circulation—quite frankly would prefer a wilderness where two dozen men may hunt bear to a scenic reservoir which supplies power, light and water to half a million people. Somewhere between this view and that of the ultra-utilitarian who would dry up Niagara or pipe the Yosemite is a sane use of public water in the parks. The Federal Water-Power Commission is composed of three of the President's cabinet. Surely they can be depended upon to resist any unjustified raid on the country's natural beauties.

But if the scenery preservers are strong enough to force the park water powers out of the hands of the commission, it is to be hoped that Congress will, at least, make such a law as will permit utilization of such waters by congressional permits under the conditions of the water-power act and thus remove the old difficulties of possible revocation and inadequate return which restricted development in the past. Much of the most necessary and valuable power in the country is within the limits of national parks, and their development with proper precautions against vandalism is only a reasonable utilization of our national resources. Further than that, there are movements on foot to extend park areas into districts now under prospect for water power and thereby close up any further development in most necessary locations.

Blanket permission to use any and all power, and blanket prevention of the use of all power in wide areas which have nothing in common except that they happen to be in national parks, should equally be prohibited. A middle course is easy to pursue.

Secondary Boycott Illegal

ON JAN. 3 the U. S. Supreme Court declared the secondary boycott illegal. By the secondary boycott is meant persuasion or force to prevent the sale of the product of a manufacturer whom it is desired

to embarrass. In the case at issue the Duplex Printing Press Co., of Battle Creek, Mich., had refused to recognize a closed union shop and the International Association of Machinists (the machinists' union) not only called a strike at the plant but refused to set up Duplex presses throughout the country and by threats and persuasion endeavored to coerce union men and others against hauling and installing the presses. Other ways were also tried to prevent the sale of presses manufactured by the Duplex company. Such action on the part of the machinists' union was held to be a conspiracy in restraint of trade and the union was adjoined from continuing the illegal action. The union maintained that under the Clayton act it was exempt from the operation of those sections of the Sherman act which had been held to apply to unions in the Danbury hatters' case. The court held that there was nothing in the Clayton act "to exempt such an organization [a labor union] or its members from accountability where it or they depart from its normal and legitimate object and engage in an actual combination or conspiracy in restraint of trade." We have no doubt that popular judgment will approve the jurists' decision, for such a method, if legal, could well be used to ruin business enterprises utterly.

Thoughtlessness on Immigration

IT IS very easy to get the American people—or, at least, groups of Americans—excited. When emergencies arise our first impulse is to act, not to think. Just now a strong group wants a tariff prohibitive of the import of certain products, particularly food, without giving any thought to the vital importance of our export trade to Canada, the chief country that would be affected by the food clauses. Similarly, others are greatly excited over the prospect of tremendous immigration. They rushed to Congress and urged a bill to prohibit immigration for two years. The time limit has now been cut to one year, but the bill, nevertheless, is a response to the American impulse to act rather than to think. In this issue, p. 57, will be found some pertinent facts on the immigration situation. The 15,000,000 prospective immigrants, sometimes held before us as a bugaboo, could not be brought over in less than eight and a half years, while the 25,000,000 immigrants, the bugaboo erected by others, could not all get here in less than fourteen years. Moreover, the figures indicate that the total net immigration for the fiscal year ending next June will be about 700,000. Again, it needs to be emphasized that by rigid enforcement of present laws the undesirables—on mental, moral, physical, political and economic grounds—can be successfully kept out. The only urgent action needed, then, is to better our immigration service and enforce the present laws. It would not be contended, however, that our present immigration policy is satisfactory. The mere fact that the present agitation has made such headway is proof that we have not an immigration policy that is generally regarded as fixed or satisfactory. In fact, we need a very thorough study of the whole immigration problem to the end that we may lay down a sound policy based on adequate consideration of all the factors. Involved would not only be the qualifications for entrance and the machinery for enforcing immigration laws but also provision for guiding the immigrant until he becomes established in the new country. Less action, less hysterics and more thinking are needed on the immigration problem.

Highway Bridge Situation

SERIOUS concern has developed in some parts of the country over the condition of highway bridges. Improvement of roads has outrun the improvement of bridges, and the problem presented by the tremendous highway construction program has been such as to make it impossible to give due attention to strengthening structures. Though these had long given satisfactory service, the rapid spreading out of heavy motor truck traffic has now gone ahead of the improved highway and has made even the remotest country-road bridge an object of concern. The gravity of this situation in New Jersey, for example, caused a newly appointed highway commissioner to resign a few weeks ago; as soon as he had opportunity to become familiar with the problems of his position he saw that the bridges of the state as a whole were in need of thoroughgoing revision, and he chose to avoid becoming involved in a situation of potential danger when funds to correct it were not available. A similar note of alarm was sounded about the same time by a number of state highway-bridge engineers who formed a committee of the American Association of State Highway Officials to consider the subject of bridge reinforcement. On the other hand, M. W. Torkelson sets forth in an article printed on page 61 of this issue that Wisconsin's situation is very much better. He introduces his discussion of bridge renewal and reinforcement by a thoroughly reassuring statement that present—and immediately prospective—road traffic does not menace the integrity of the state's bridges. Possibly the contrast finds an explanation in a difference of conditions between the East and the Middle West, since there is reason for believing that New Jersey is not alone in facing a large bridge reconstruction program. Some inquiries as to this point have been begun by *Engineering News-Record;* the facts which they will reveal will be published as soon as available.

Federal Highway Appropriations

IT IS intimated from Washington that the proposed appropriation of $100,000,000 each year for the next four years for federal aid for highway construction is likely to be cut down. This is the less serious because there is so much money still unexpended from the previous appropriation. The essential feature is to get Congress to recognize by a substantial appropriation the necessity for continuity in the federal-aid scheme, so that when conditions are again favorable the $100,000,000 annual appropriation may be restored. This will not be a popular view with those who believe in "no compromise" and who maintain that whatever other economies are effected the road building schedule should not be interfered with. It is entirely true that one can show with pad and pencil that every dollar judiciously expended in highways yields a profitable return to the community, but, as was emphasized in this journal several weeks ago in discussing the necessity for federal economy, there are times when the best business judgment demands a husbanding of resources. Such a time now faces the federal government. Nevertheless, the strong presentation of the needs for highway construction in this country made in support of the $400,000,000 program was fully justified. Otherwise Congress might not have gained an adequate idea of the part that highway improvement should play in the federal government's program.

TO BE assured, however, of a continuance of federal appropriations for highways those interested in roads must present a united front. It seems likely that there will be a confusion of counsel. There are those who contend for a national system, built and maintained exclusively with federal funds. There are the federal-aid advocates, who believe in the present plan. Another group—composed of farmers—wants federal aid to extend to the county as well as to the state systems. Still another group would like to see federal appropriations for road work entirely abandoned, which would be nothing short of a calamity. State highway department organization, generally, has not yet reached the stage where it can proceed without the backing of federal money. Should this confusion of counsel reach Congress it may be eagerly welcomed by those who want an excuse for making no appropriation. Under the circumstances the reasonable ground for compromise is on the federal-aid plan as now operated. It is established. It has won general confidence. It has the backing of state highway departments in every part of the country. It stands midway between the "national" plans and no appropriation whatever.

AS JUST intimated, the federal-aid plan has won wide approval. Operation has disclosed no major direction in which change is needed. There is one amendment, however, that is desirable; namely, to require that the sum equivalent to the federal grant be appropriated by the *states themselves* and not by the counties. In some sixteen or seventeen states the counties, not the states, match the government's funds. The result is that all the county money, as a rule, is spent on the primary system, which is essentially of state-wide importance, leaving no money for the important secondary system, which should be the county's main—if not sole—responsibility. Another serious result of this practice is that cities escape from paying for the road system in fair proportion to the wealth that they gain from an improved state-wide highway system. From both standpoints the practice of shifting the financial load to the counties results in unsound highway policy. This the federal government should not countenance or encourage. A provision should therefore be introduced in the next appropriation bill making the states themselves appropriate the local quota to match the federal funds. In some states constitutional amendments will be needed. But, as shown repeatedly when highway issues have been at stake, such amendments can be secured.

Street Traffic Control, an Outstanding Engineering Problem

WITH exception of a few cities, street traffic control is in the hands of the police. This has been a gradual growth from the days when the only road rules required were right-hand running and superior rights at crossings, to the present-day vogue of the traffic policeman and block signals on our busy thoroughfares. The situation now is fast getting beyond the police power, which can only regulate. It has become an engineering problem.

The crowded and dangerous streets of even our small cities, the difficulties of travel on them by foot, in automobiles, and in street cars, and the consequent effect of these difficulties upon real-estate values and upon retail business, to say nothing of the comfort and safety of the people, make this the big municipal problem of the next ten years. Its solution calls for something more than merely directing such traffic as chooses to use the streets. It has become a problem of traffic distribution and removal, strictly comparable to that which the street-railway and rapid-transit engineers have long attacked.

Obviously, the trouble is due to the automobile. A city of 100,000 today has more vehicles moving downtown per capita or per street than a city of 1,000,000 ten years ago. The per-capita street-railway travel has probably increased but little, so that any city's rapid-transit difficulties are due to its increased size and not to new factors. But the automobile is a new and serious element, and the self-driven automobile, which means in most of our cities the parked automobile, is the real disturber.

This parking evil, so common in all but the largest cities, must be attacked more vigorously. When automobiles are lined up on either side of a 40-ft. street which already has two car tracks, it is not surprising that congestion results. This condition must be recognized as impossible. If the occupants of downtown offices must run their own automobiles, some other place than the city streets must be provided to care for them. Anti-parking ordinances, unpopular as they are, will have to be insisted upon.

Such regulation and a more rigid insistence on the duties and powers of the traffic policeman are within the power of the police. Greater rigor in the enforcement of traffic laws will also help much, but there must be further steps which only the engineer can take.

Studies must be made of street-travel routing, just as studies are now made of street-car routing. One-way streets are a great help. Boulevards can be cut from outlying districts which will bring travel to distributing centers clear of the main traveled routes in the city itself. Just this thing is now proposed for Seattle, where a new street is contemplated which will have no grade crossings and which will serve the farm and industrial districts to the south. Through routes may be provided in or around the city whereby travel from one suburb to another on the opposite side does not have to go through the heart of town or along streets used by those reaching the center of the city itself. In other words, the distributing of traffic recommended for transit lines in these columns some weeks ago must extend to vehicular travel. Finally, it is only a question of a short time in a number of our larger cities, at least, before under- or over-crossings will have to be provided. 34th St. and Fifth Ave., and 42nd St. and Fifth Ave. in New York must come to this soon; at Third and Market Sts., in San Francisco, the city engineer has already designed a subway crossing for pedestrians. There are a dozen other cities where such passageways should be built as soon as costs are more favorable.

All of these steps present engineering problems. The trouble is that they have not been commonly applied to city traffic because the engineer has been too willing to assume that that is merely a matter of public welfare and so outside his bailiwick. The serious congestion in our downtown districts and the mounting death list of our streets makes it a public duty for the engineer—and particularly the city engineer—to insist on being heard and to begin reforms which will lead to safer and more bearable street conditions.

Groundwater Pumping and Hydraulic Excavation for Beach Hotel Foundation

Column Footings and Basement Story Below Water Level Constructed in Open Pits Kept Dry by Well-Point Cofferdams—Piling Eliminated—Site Pumped in Sections by Local Groups of Wells—Ejector and Dredge Excavation

SUCCESSFUL application of groundwater lowering to foundation work in fine sand for two hotels on the beach at Atlantic City, N. J., during the past year has demonstrated the easy practicability of founding structures along the beach at considerable depth below tide level, and promises to lead to a distinct change in local building practice. In past beach-front construction at Atlantic City, buildings have been carried down only to water level, just below street level, and have been supported on pile foundations. The new Ritz-Carlton Hotel, now under construction, and a just completed extension to the Ambassador Hotel, however, have basement stories carried 10 to 25 ft. below water level by the help of well-point pumping. With this deep construction the columns and walls could be founded on spread footings directly on the sand, while important constructional advantages were gained not only in the elimination of piles but also in the increased space and the more efficient arrangement of interior, resulting from the presence of a basement story.

Groundwater lowering was used for the foundation work of the extension to the Ambassador Hotel late in 1919. The Ritz-Carlton work, done during the past fall season, was carried out by the same contractor with a more highly developed method, described in the following. In both pieces of work the sand was excavated in the open, *without sheeting*, to depths exceeding 15 ft. below mean tide, without difficulty or delay, in spite of the fact that in the latter case the work was located within 100 ft. of the water's edge. This result was made possible by encircling the work by lines of driven wells, pumping down the water and in the sand to a level below the floor of the excavation. The fineness of the sand and its stability when dry made the method particularly effective, as the pumping capacity required was moderate, changes in groundwater level were relatively slow, and the excavation stood with vertical banks that showed no tendency to crumble.

Under municipal building regulations of Atlantic City, structures on the beach front must be founded on piles. When the landward extension of the Ambassador Hotel was designed (the existing portion occupying the boardwalk frontage of the site), pile footings were designed for the walls and column bases below the basement floor, at 15 tons per pile on 2-ft. spacing, or the equivalent of a little less than 4 tons per square foot of footing area. However, as the excavation developed the firm nature of the sand, it was decided by the architect's consulting engineer, H. G. Balcom, that the piles could be omitted, thereby not only saving cost but eliminating the slight settlement that it was feared would result from building upon jetted piles. This change was allowed by the local building authorities, the more readily as the work to be done was not directly on the boardwalk, being in a measure protected from the ocean by the front portion of the building, which rested on piles. Later, when the same architects designed the Ritz-Carlton Hotel, a few hundred feet to the north, Mr. Balcom again pro- riences at the Ambassador site, and this was finally allowed by the building inspector in spite of the fact that the work fronted directly on the boardwalk. The loading used was 3¾ tons per square foot, as in the case of the Ambassador extension (where the footings were not changed in size after it was decided to omit the piles). However, extra precaution was taken to secure a high degree of scour protection at the beach frontage of the building, partly by constructing a pile and plank bulkhead about 20 ft. in front of the building, and partly by carrying the front wall footings to a depth of 8 ft. below basement floor or about 22 ft. below water level.

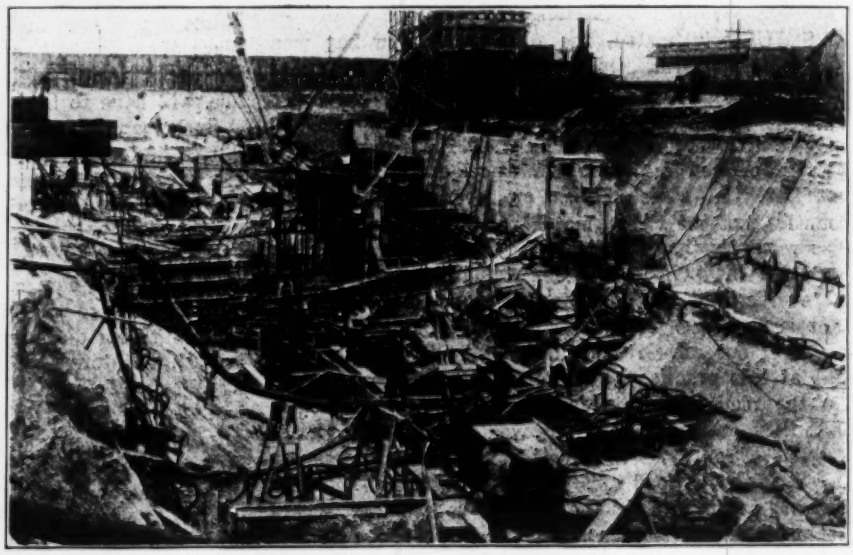


FIG. 1. WELL-POINT COFFERDAMS IN RITZ-CARLTON FOUNDATION WORK, ATLANTIC CITY

In applying well-point pumping to the Ambassador, a single "cofferdam" was constructed around the whole site by encircling it by a ring of wells pumped as a single unit. The Ritz-Carlton work is distinguished by extensive subdivision of pumping and construction work through the use of many local rings of well points constituting separate "cofferdams." This expedient permitted progressive working from one end of the site toward the other, gave remarkable flexibility and

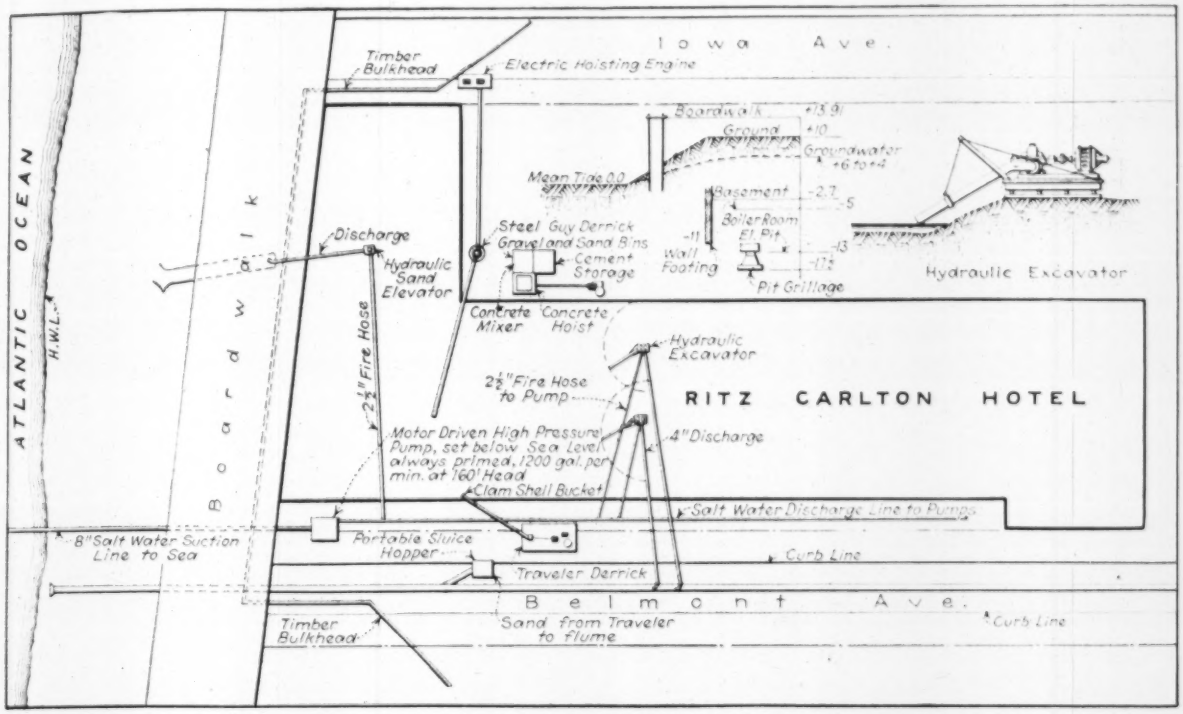


FIG. 2. SITE AND PLANT LAYOUT, RITZ-CARLTON HOTEL FOUNDATION

adaptability to changing conditions, and, together with the practice of lowering the groundwater in successive stages by using several tiers of wells as excavation proceeded, gave marked economy in both plant cost and pumping cost.

A general view of the Ritz-Carlton foundation work is given in Fig. 1 herewith. The plan Fig. 2 gives the layout of the principal fixed elements of the construction plant, but not of the wells, and shows the shape of the building and its relation to the beach front

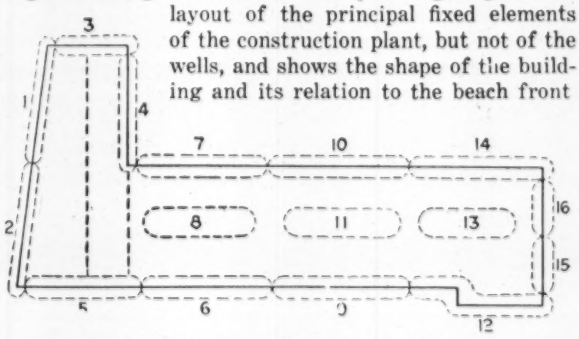


FIG. 3. WELL-POINT LAYOUT

The relative elevations are indicated by a diagram sketch above the plan. Groundwater is several feet above mean tide, and receives its supply from the land rather than the ocean. The soil is sand to indefinite depth, in practically horizontal layers, varying somewhat in characteristics, but in the upper 15 or 20 ft. of uniform fine grain, practically all passing a 50-mesh sieve. The supporting power of this sand was demonstrated by a loading test carried out on the floor of the excavation at the Ambassador extension site (see *Engineering News-Record*, Nov. 4, p. 890). A sand bin was framed around four upright 12 x 12 corner timbers, whose ends rested on the sand floor; a total load of 47½ tons produced 1½-in. compression, but no further settlement occurred when the final load was left on overnight; even allowing the groundwater to rise up to the pit floor by reducing the pumping did not produce more than 0.001 ft. additional settlement. The test was considered to show the assumed footing loads to be conservative.

The plant shown in Fig. 2 includes a traveling clamshell used in excavating for the wall footings along the Belmont Ave. side of the building, a derrick for clamshell excavation and handling materials, a concreting tower, a water-supply pumping plant, a sand ejector, two movable sand-pumping plants, and a sand discharge flume. The timber bulkhead shown on the ocean side of the site was built as a safeguard against any abnormally high water reaching the excavation and flooding the pit. The well points and the pumping plants for them are not shown.

A small-scale sketch indicating the layout of the various sets and rings of well points and their sequence is given by Fig. 3. As the numbering shows, work was carried on progressively from the boardwalk end to the rear end of the site, and at any one time only such a length of well line was used as the work in hand required. Sometimes an incomplete ring was sufficient, as at the footing shown in Fig. 4, but generally the wells formed a closed ring around the section to be constructed.

The wells consisted of lengths of 1½-in. pipe fitted with well points 30 to 36 in. long wrapped with 60-mesh screen, which were jetted down into the sand at intervals of from 3 or 4 ft. to as close as 18 in., usually closest in the lowest tier. The cap of each well pipe connected by 1½-in. wire-covered hose to a 4-in. steel pumping main, to which were connected one, two or more (up to four) electrically-driven pump units of capacity from 75 to 200 gal. per min., discharging by pipe line to the beach. Each of these units was mounted on a platform so as to form a portable unit that could be shifted around by the derrick, as may be seen in Fig. 1.

In jetting down a well point, a 1½-in. jet pipe supplied with water at 40 lb. pressure was pushed down into the ground and moved around or churned as necessary to loosen up an area large enough for the well pipe; the well pipe with point was then dropped into the soft sand loosened up by the jet.

Generally the points were put down to depths of 10 to 20 ft. However, the details of the well-point work throughout, as to depth, spacing, pumping capacity, and the like, were fixed as experience dictated, the system adapting itself very flexibly to any required changes. When a particular area of the site was to be excavated to a lower level, for example, a ring of points was sunk around the area, at possibly 4-ft. spacing, to 5 or 6 ft. depth, and pumping and excavation started simultaneously. If these wells did not draw down the water rapidly enough, or if the ground proved wet in excavating, a set of points was jetted down intermediate between those already in. If the pumps were not able to hold the vacuum another pump was cut in. Hose and pipe connections were checked up for tightness frequently, this being vital to good results. When the excavation was down 4 or 5 ft. a set of points was

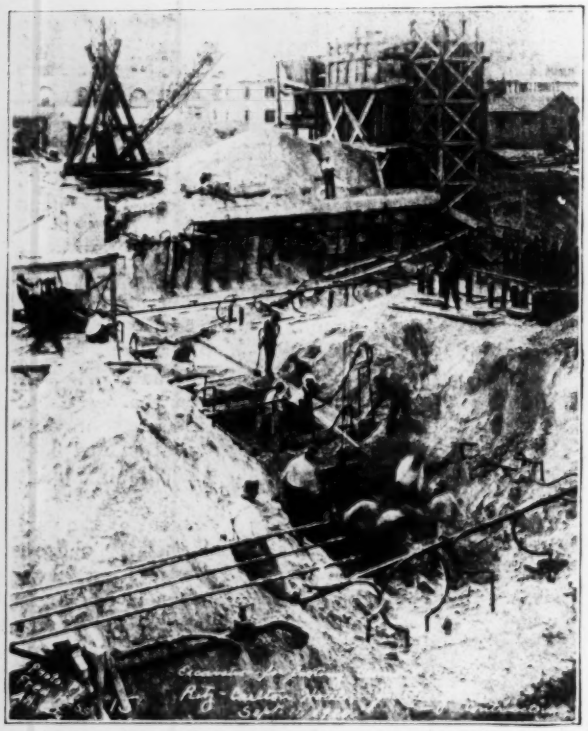


FIG. 4. COLUMN FOOTING EXCAVATION PROTECTED BY PARTIAL RING OF WELLS

jetted in around the bottom of the pit to lower the water level farther, excavation then continuing inside this smaller ring.

On the whole, experience at this site was that the groundwater level could be lowered 10 ft. in about 4 hr. (with 10 to 12 ft. of lift and about 30 ft. total raise from foot of well to discharge). The return of the water was relatively slow, so that when pumping was stopped it would be half an hour before water came up through the floor of the excavation. The pumpage is fairly represented by the experience with the longest

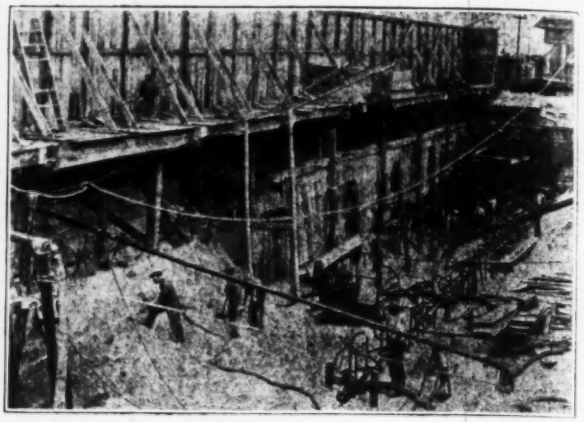


FIG. 5. JET AND EJECTOR EXCAVATING SAND AT FRONT WALL (SECTION 2)

continuous line of wells used in the whole job, that existing at the time the footing excavation for the front and short side walls was in progress. At this time the total length of the line of wells was something over 300 ft., and the pumpage averaged 300 gal. per min. A vacuum of 12 in. to 20 in. mercury was carried at the pump. This was at a distance of less than 200 ft. from the edge of mean tide.

Work was started at the beach end of the site, first on the right-hand half of the front wall, the other half being started (Fig. 5) only after the deep wall footing of the first half had been constructed and the principal hazard of interruption of the pumps was over. Then the side wall and part of the rear wall of the L were taken in hand, then a section of the opposite or Belmont Ave. wall. When the next sections of side wall were started, the entire front section was cut off by a line of wells and general excavation over the forward portion, which had previously been started, continued down to floor level. Underdrains, concrete base, waterproofing and final concrete floor were then put in, which took care of further drainage in this section and released the wells and pumps.

Construction of the column footings, comprising steel grillages set on waterproofing on a concrete sub-floor in a pit excavated below basement level, was carried out in each instance as a separate operation after the basement excavation was down to grade. The detail arrangement in each such minor piece of pumping depended on the circumstances existing at the time, on whether one, two or more column footings were taken in hand simultaneously, and the like, as may be seen by comparing Figs. 1 and 4.

Some complications occurred in excavation at the rear wall. Here an adjacent dwelling house, only 10 ft. away from the wall, had to be protected from settlement, and this rear wall was sheeted—the only sheeting in the work. Here also occurs the deepest point of the excavation, as the boiler pit is located at the rear wall and a group of cantilever foundations had to be put in below the pit floor. With some complications, however, this work was carried out by the same procedure applied elsewhere on the site.

Hydraulic Excavation—About three-fourths of all the excavation was done by the hydraulic method, using two different types of plant: water-jet ejector and suction-dredge. A single ejector was used for the larger part of the beach-front L (Fig. 5) while the rear or body

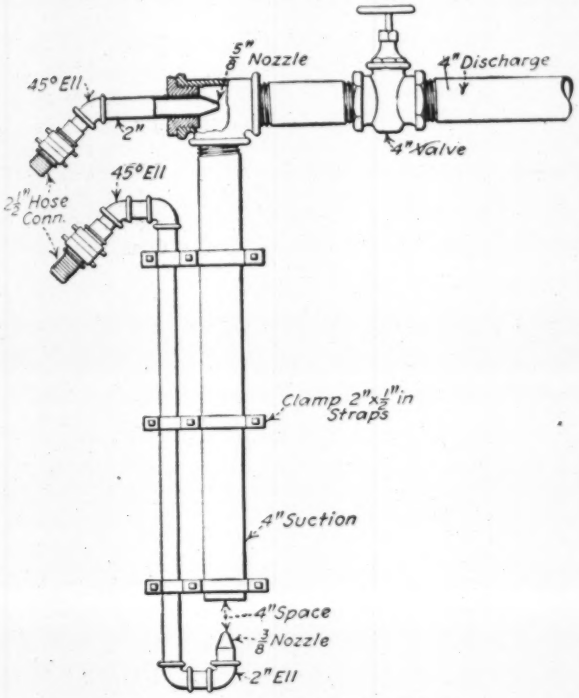


FIG. 6. SKETCH OF EJECTOR RIG

of the site was excavated by two dredge-pumps.

The ejector, Fig. 6, comprised a 4-in. riser pipe, a 2-in. water jet pipe turned up in the lower end of the riser and ending in a ⅜-in. tapered nozzle, and a similar horizontal jet in the tee at the head of the riser pipe, facing toward the discharge pipe. A total of 5,000 cu.yd. of sand was removed by this ejector. Water at 150 lb. pressure was supplied to it by a 2½-in. hose from a booster pump drawing from the 8-in. delivery main of a salt-water pumping plant installed alongside the building site, below sea level.

Practically all the ejector work was done at full depth, requiring 15 to 27 ft. of lift. After the deep front wall had been put in (about 10 ft. deep below basement floor level) in inside and outside forms set in hand-excavated trench, the basement excavation itself was started with the ejector working at floor level just inside the wall. Hose (Fig. 5) supplied water to wash sand to the sump in which the ejector worked.

While the excavation of the front half of the L was in progress, the side and rear walls were not yet completed (note sequence of well-point working in Fig. 3), and during this period a line of points was maintained through the middle of the L, protecting the front half from the groundwater coming from the land side. Later, a line was put in at the rear of the L to permit excavation of the second half.

Under the conditions, the performance of the ejector necessarily varied over a wide range, but at its maximum it delivered 15 cu.yd. sand per hour, representing a burden of 17 per cent of the water discharged.

More definite performance figures are given for the two dredges. They worked at an output of 15 to 20 cu.yd. sand per hour each, when carrying sand as high as 25 per cent of the water; this was a heavier burden than the average, however, 10 to 15 per cent being more generally obtained.

Each of the two dredges (Fig. 7) consisted of a motor-driven centrifugal pump of normal capacity, 200 gal. per min. at 1,100 r.p.m. speed, mounted on a platform carried on skids, and a downward sloping suction pipe held and manipulated by suspension from a swinging wooden jib on the back of the platform. The suction could be swung through a full semicircle, and one dredge was able to work a strip 30 ft. wide, excavating to 10 to 15 ft. depth below skid level. The two dredges, working abreast of each other, covered the width of the excavation, and moved back from front to rear, in two successive lifts. Their work was supplemented along the Belmont Ave. side by clamshell digging done by a traveling derrick at street level.

Each dredge pump had a pair of agitator jets alongside its suction head, supplied by a 2½-in. fire hose from the force main of the salt-water pumping plant already mentioned. It discharged by 4-in. steel pipe to a wooden V-shaped flume carried on trestle along Belmont Ave. to the beach. As the slope of the flume was necessarily quite flat, auxiliary jets were placed in it at various points, to keep the sand moving.

Rapid work was made possible by these construction methods and devices, supplemented by an efficient central concreting plant delivering from a 60-ft. hoisting tower. The work was practically all done in four months, August to December. Steel erection could be begun in the front half of the building while the footings in the rear half were still under construction. At present two-thirds of the steelwork is up. Concrete encasement coated with waterproofing was built around the columns up to groundwater level, though the underdrain system under the basement floor is designed to keep

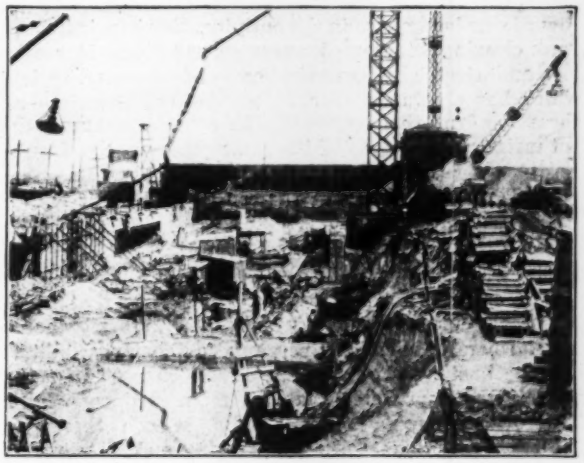


FIG. 7. EXCAVATION BY HYDRAULIC DREDGE

both concrete and steelwork dry. The pump discharge from the underdrain system will be used for service water in the hotel. Drinking water, however, will be obtained from the city supply.

The Ritz Carlton Hotel was designed by Warren & Wetmore, architects, under the personal direction of Julian Holland of that firm. H. G. Balcom is consulting engineer. The Thompson Starrett Co. is the general contractor. The foundation work was sublet to James Ferry & Sons, Inc., James V. Ferry of that company having planned and carried out the substructure work, assisted by William Shappell as superintendent and George W. Schusler as engineer.

Observations on a Pacific Coast Trip

By Frank C. Wight
Associate Editor, *Engineering News-Record*

Los Angeles the Crowded

In December, before the big rush of tourist travel began, railroads in Los Angeles reported that there were 2,000 more people coming into town each day than leaving it. This seems incredible, for with its amazing growth of 81 per cent in the decade 1910-20 the daily increase was only seventy, but any one who tries to walk on the downtown streets of Los Angeles or to patronize its street car-system will readily believe it. More people are "milling around" there than in any other large city in the United States. How much of this is due to local custom, which, according to some, rules that every one should walk Broadway at least once a day, how much to the justly famous and occasionally mentioned climate which beckons one to outdoor exercise, is hard to tell. But the folks are there pushing and weaving by each other from curb to show window as though every day were circus day and the parade about to pass.

These street crowds are but the obvious manifestation of the phenomenon of Los Angeles, a city practically without industries, except the making of motion pictures and the pumping of oil, which partly by territorial acquisition but mainly by influx of new residents jumped from 319,198 in 1910 to 576,673 in 1920, and from seventeenth to tenth place in the list of American cities. There are plenty of other signs of growth—new office and theater buildings under construction at practically every downtown corner, a building permit record for November second only to New York's, row after row of new bungalows in the outlying districts, increased bank clearings, increased water consumption, increased gas and electricity consumption, and a sewer system which has absolutely reached its limit of capacity—all these confirm the census statistics and warrant the enthusiatic predictions of the somewhat dazed residents. Los Angeles is booming almost as much as its press agents are trying to make the country believe it is.

Industries Must Be Developed

The whys and wherefores of this boom have no particular engineering significance. It is true that many of the newcomers are non-producers, retired merchants and farmers to whom the perennial outdoor possibilities and the bustle and excitement of the busy city equally appeal. It is probable that the main business of the big crowds is buying from and selling to each other, with the ramifications of collecting, storing and distributing that such merchandising requires. As such the enormous population increase appears anything but healthy and its end not far away, for the congestion due to such rapid growth would soon discourage further growth from among the comparatively leisure class. So for the future Los Angeles must look to a greater industrial development. It is not enough for it to be a market, it must become a manufacturing center.

There are signs of such a development. The great Goodyear plant is always pointed out to critics; but, unfortunately, that plant was completed just at the recession of the automobile boom this year and has never functioned as intended. It is there ready for business, however, with a cotton-producing country at its back door, rubber sources across the Pacific, and with a climate and adjacent farm lands which should offer all the attraction in the world to labor. Some of these advantages apply equally to other industries, particularly the appeal to labor. To listen to the Angelenos, a workman should be willing to work only for his keep, just for the privilege of having his own year-round garden and no coal bills. Certanly one cannot go through a bungalow colony or travel along the San Fernando valley on a December day without recognizing some basis for these claims. The Pacific Coast market is limited, however, and the Pacific foreign market subject to many forces other than the ability to produce. There is still room for many more industries in the Los Angeles district but Los Angeles will not reach the magnificent proportions it forsees until these Pacific markets grow. Then Los Angeles will grow with them, on a more substantial base than it is now building.

But whatever the cause or the prospects of the Los Angeles boom, its existence gives rise to many engineering problems. You cannot pile several hundred thousand people into a city in a decade without making it difficult to take care of them properly in the meantime. Fortunately for the city, proper foresight has insured an adequate water supply, which, while not completed, can be added to annually well ahead of the demand. Such additions are constantly under way; new dams and reservoirs in the distributing system are under construction, old pipe lines are being replaced and new irrigable areas are being opened. It is an old saying in the Southwest that water is king; it is more than that, it is life itself, in Los Angeles. To the visitor from a humid country the most notable thing in the aqueduct system is the intermingling of the domestic and irrigation service. The same mains that bring the water to the houses distribute it to the fields, and as the city moves toward the fields the irrigation supply is turned over to domestic use. Water in this country is not merely something to drink or to wash in.

Sewage Situation Serious

But if the water supply is cared for, the sewage is not. As noted in a separate article soon to appear, the situation is most critical, and the citizens who have twice by popular vote refused to consider it must be forced into action. It is publicly predicted by the city engineer that by next spring sewage will be standing in Los Angeles streets and that all new houses and probably some old ones will have to build cesspools. It is rather strange that in the new plan for disposal there is not more said about utilizing the sewage for irrigation. In a country where every drop of water counts it is surely wasteful to pour all the city sewage into the ocean. The subject, of course, is not a new one in Los Angeles and the city engineers probably know more about the prejudice against sewage utilization than any one else. At the same time they are now up against an emergency which requires an immediate remedy and does not permit of the necessary public education and longer study that some irrigation disposal of sewage would require. Some day, though, a means of utiizing the sewage flow must be found.

The traffic situation in Los Angeles is intolerable. This is another sequel of the rapid growth that requires engineering attention. It is not only because so many people afoot or in vehicles move around the city, but they are so regardless of traffic rules. On Broadway, for instance, there has been installed a new system of block

signals which shift to "Stop" and "Go" simultaneously along the whole street. Theoretically it is a good scheme; practically the signals are inconspicuous and the policemen do not enforce their observance. The "jay walkers" scoot across the street at their own volition and peril, and motorists take special delight in evading both signals and policemen. Engineers can do little to educate both people and police, but they can offer the first solution of any traffic problem—that is, to distribute the causes of congestion. To that end the city engineer is planning boulevards around the center of the city to remove from downtown the many vehicles which go from one suburb to another on the opposite side of the city, a very considerable part of the traffic in Los Angeles, which has suburbs practically completing the circumference of the city.

Planning is also being done for more highway tunnels and better ventilation of the existing ones, and the utilities commission engineer is trying to rearrange the street-car routes. Downtown Los Angeles was never intended for a big city. The sidewalks and streets are too narrow, and the street-car layout prepared on the principle of having every car pass every store. To remedy these evils requires a revolution, not only physical but also in the minds of merchants and citizens. This is too much to expect an engineer to accomplish, but constant hammering on the possible cures which an engineer can make will in time have some effect. Two people a day are being killed in the streets of Los Angeles; there is no pleasure in getting around in the business district. Sooner or later the people will realize that safety and comfort are worth more than the advertisement of the overcrowded street.

Mexican Interests Great

With all of the building and enlargement going on in Los Angeles there is, of course, a great deal of work for the engineer, but the engineers living there have more to do than merely to take care of the city's needs. The city is the center for the Southwest, just as San Francisco is the center for the West in general. As far East as New Mexico and well down into old Mexico extends their field; and water power and irrigation, as in the other big Western cities, are the main things that interest them. Mexico, particularly, is a live field, much more live than most Easterners know about, though it is a Mexico which differs from the oil-field district of the Gulf or even the mines of the interior. It is that country rich in agricultural possibilities which lies south of California and which is as far separated physically from the city of Mexico as it is from Minneapolis. All it needs for its development is a stable government and the aid which the engineer can give. Both are apparent on the horizon. The prospects are that the next ten years will see irrigation development south of the line comparable to anything which exists in the States, and Los Angeles will be the main center from which the work will be directed.

At the recent General Contractors' dinnner in Los Angeles one of the city's leading bankers made a speech. Whatever it started out to be about, it soon reached a not altogether unexpected subject—the beauties and wonders of Los Angeles. "There are those," said the speaker, "who will tell you that the future of Los Angeles is restricted by its lack of water. I have been hearing that cry for thirty years, but I notice that as we grow we always manage to get the water we need. Nor do I worry about the future. If the people of the United States are so attracted to this garden spot of the world *[loud cheers]* that they come here to the number of two or three million, as they unquestionably will in the next three decades, then I know that the Mulhollands and the Lippincotts of that time will find water for Los Angeles if they have to pipe it here from the Penobscot."

This quotation—as nearly accurate as memory can recall the spoken thoughts of an Angelene talking of his own town is submitted not as a warning to the State of Maine of the proposed invasion of its water rights, or even as a tip for prospective business to pipe and pump makers, but because it seems to be a perfect example of the Los Angeles spirit. There is that touch of super-enthusiasm which, unfortunately for Los Angeles, has made its boosters a byword in the rest of the country, but there is also the acknowledgment of basic conditions, and faith in the solution of difficulties which must carry the city ahead to success.

The Status of Immigration

No Cause for Hysteria—Selective, Not Restrictive, Measure Recommended, but Enforce Present Law First, Says General du Pont

ILL-CONSIDERED statements from public men based upon hearsay or speculation, rather than upon facts, are the basis, says General Coleman du Pont, chairman of the board of directors of the Inter-racial Council, for what fear there exists that "our native civilization" is in danger of being "blotted out by the succeeding layers of immigration from Europe." Disregarding official immigration figures, the authors of these statements, continues General du Pont, endeavor to impress upon the public the need for a closed-door policy by asserting that 25,000,000 prospective immigrants are awaiting the opportunity of entering the United States. This he refutes by the statement that, under the best conditions, and with the present transportation facilities, it would take fourteen years to bring 25,000,000 people from Europe here.

Rigid enforcement of the existing immigration law, with additional legislation if found necessary by a non-partisan commission that can study the situation dispassionately and scientifically—"that will provide for the effective distribution of immigrants, an intelligent policy of assimilation, and the establishment of proper facilities for those entitled to naturalization," is the view of General du Pont. He believes that, were the laws as they stand to be enforced by an adequate staff, the class of immigration that the United States would receive would be wholly of good moral character, physically sound, mentally competent, self-supporting and opposed to violence and revolution."

In answer to the argument, often advanced, and particularly now, that unlimited immigration would mean greatly increased unemployment, a lowering of the standards of living, and destruction of the wage scale, Gen. du Pont has the following to say:

> There is a great deal of exaggeration about the volume of immigration now pouring into America. Misapprehension prevails as to the relation of the present immigration to the existing market for labor. The statement has been made in the House of Representatives that unless the "flood gates are closed, the standards of living will be lowered, unemployment already estimated at two million men will run rampant and the wage scale destroyed."

It is a significant fact that for the fiscal year ended June 30, 1920, the total permanent increase in the alien male population of the United States was merely 9,877. According to the analysis of the official figures of the Bureau of Immigration, 10,000 more aliens left for, than came from, the countries of Europe for that fiscal period, and the bulk of the total increase in our immigration alien population came from Canada and Mexico. The United States lost 102,000 emigrant laborers and gained 49,185 skilled, 9,063 professional people, 12,500 farm laborers and 31,000 servants.

An immigration official has been quoted as estimating that the immigrants who will have come to this country before Jan. 1, 1921, will number more than 1,200,000. Yet for the five months—July, August, September, October and November, 1920,—a total of 472,859 immigrants arrived in the United States, according to records of the Department of Labor, and during the same period, 181,505 persons left the United States. This leaves a balance in favor of immigration of 291,354 for the five months. All other statements to the contrary, notwithstanding, it is made evident by these official figures that we will not have as large a net immigration as during 1914, when the net immigration was 769,276.

The following are the figures on total immigration and total emigration from July 1 to Nov. 30, 1920:

	Total Immigration	Total Emigration	Total Immigration
July	83,959	39,505	44,454
August	86,500	43,800	42,700
September	98,400	31,200	67,200
October	101,000	33,000	68,000
November	103,000	34,000	69,000
	472,859	181,505	291,354

The average net immigration per month beginning with last July was 58,271. If this average should hold for the remainder of the fiscal year of 1921, the total net immigration would be 699,252, which would be less than the immigration for 1913 and the immigration for 1914.

As to the immigration bill that recently passed the House of Representatives, and is now before the Senate, Gen du Pont asserts that "it fails to apply scientific principles to immigration." Its passage, he declares would result in the exclusion of able-bodied, unskilled workers, "in the face of the fact that we received in 1920 proportionately fewer unskilled immigrant workers than in any recent year of normal immigration." Further discussion of the bill leads him to the following conclusions:

We must realize that what we are now experiencing is a business slump due to temporary conditions that need no discussion here. These conditions must necessarily disappear, else we have come to a sorry pass. And when these conditions have been removed, and provided the bill to restrict immigration has been made law in the meantime, we may witness a shortage of unskilled labor that may cripple the manufacture of goods for export and tax our capacity to meet the demands at home. Such a proposal is economically unsound, and if public opinion is enlightened on the subject it will not become a law.

Enforcement of Existing Law

If undesirables are getting into this country, the blame rests, says Gen. du Pont, with enforcement officers, inasmuch as the existing immigration law specifically names classes that must be barred because of mental incompetence, moral laxity, physical weaknesses, political radicalism and economic dependence.

Through the raising of a cry that all classes of immgration must be barred because of the danger of poisoning our native civilization, Gen. du Pont believes that a most effective barrier to the Americanization of the foreign element already here is being set up. Calmer council should prevail, he advises, and if immigration and the foreign born must be discussed, they should be discussed dispassionately.

Policy of Inter-racial Council

The position of the Inter-racial Council as regards immigration is thus set forth by Gen. du Pont:

The Inter-racial Council is not opposed to limiting the volume of immigration to America, if, after a conscientious and liberal-minded investigation, that step is found to be in keeping with the best interest of the nation.

Such an investigation should be instituted at once and carried out under the direction of a non-partisan commission who will look over the field both in America and in Europe, studying the subject from all of its angles, scientifically, and with a view to evolving constructive policies. Immigration is too important a subject to permit of our rushing pell-mell into a program of restriction without proper consideration of the consequences of our legislation.

The council recommends principles of legislation which will consider selective immigration as one important aspect, and yet but a single aspect, of immigration. It suggests legislation that will provide for the effective distribution of immigrants, an intelligent policy of assimilation, the establishment of proper facilities for those entitled to naturalization, who, in large number, find very great difficulty in securing the privilege they have honestly earned. All these should be integral parts of a single policy. We cannot continue to interpret immigration in terms of prejudice and intolerance. It is a question of patient study and investigation, for it is closely bound up not only with our industrial prosperity, but with our civic and social development as well.

Engineering Conditions in Alaska

In his annual report to Congress, Secretary of the Interior Payne has the following statement regarding Alaska:

Ties and rails on the government railway in Alaska are now laid to mile 264. When completed the standard-gage line will extend from Seward to Nenana on the south bank of the Tanana River, 412 miles from Seward, with a standard-gage branch of 38 miles leaving the main line at Matanuska Junction (mile 151) to the Chickaloon coal mines, with a spur of 3 miles on this branch to the Eska coal mines.

Fifty-four miles standard gage are under operation from Healy (mile 358) to Nenana (mile 412), leaving a gap of 94 miles between Gold Creek (mile 264) and Healy. From the north bank of the Tanana River (North Nenana), a narrow-gage road of 54 miles is in operation to Fairbanks. From Happy station on this line, 7 miles south of Fairbanks, a narrow-gage branch of 32 miles extends to Chatanika. Total mileage in operation, 445; total when completed, 540. The clearing on the gap is practically completed, and approximately 40 miles of grading done. The entire road, including the 3,000-ft. bridge over the Tanana River at Nenana, should be completed and in operation by the end of the summer of 1922.

The Chickaloon coal mine is being operated for the Navy. A shaft of 600 ft. has been sunk and working levels opened. The coal is a fine quality of bituminous, as good as Pocahontas. The vein is irregular, and it is not possible to estimate with accuracy the amount of this coal. Eska is 20 miles west of Chickaloon. There the coal is low-grade bituminous, and is being mined by the Engineering Commission for the railroad and for domestic needs. Two leases have recently been made here to private parties. All the coal must be washed; a washing plant is in course of construction. Lignite coal in abundance is found south of Nenana, and is being mined for railroad and domestic purposes. Two private companies are operating in this field.

Organize the 13th Engineers

The 13th Regiment of engineers is being organized at Camp Humphreys, Va. The nucleus for this regiment was found in the first battalion of the 5th Engineers.

Trend of Highway Development —A Survey

California's Practice

THIS IS THE TENTH *of a series of staff articles on the highway situation. It deals with various problems concerning both design and construction of pavements, stressing particularly some rather unusual conditions that have arisen in California since the construction of California's system of the thin-slab, carpet-top concrete roads for which the state is noted.*

This review is the more interesting because there will shortly be issued three reports of investigations of California's highways—by the U. S. Bureau of Public Roads, by the California State Automobile Association and by the Southern California Automobile Association. The investigations made by engineers for the automobile associations were brought about as a result of criticism of the state's highway policy and methods. The points in controversy are not touched on in this review, since they will be fully discussed in the forthcoming reports.

The eleventh article of the series will appear in next week's issue.—EDITOR.

CALIFORNIA'S pressing highway problems relate both to design and to construction. The design problems arise from the uncertainty of the highway loads of the future, while the construction problems are not merely those due to high freight rates and to high cost of labor and materials, but to the securing of a sufficient number of competent contractors to handle the program that should be put under way in order to extend to the people as quickly as possible the benefits to be derived from the $40,000,000 bond issue, recently approved. Next season between $6,000,000 and $10,000,000 is to be expended on state road work and about $12,000,000 on county road work, provided enough contractors are available to carry out this extensive program. Some of California's problems are therefore akin to those in other states. Any inquiry into California's highway problems must concern itself with the thin-slab, carpet-top concrete road, for which the state is noted, and to the service rendered by that design.

UNFORESEEN CONDITIONS

One of the greatest uncertainties in planning new roads in California is the question of what heavy traffic, or other unforeseen conditions, will develop on the road after completion. California's experience has given the state some indication of traffic to be expected on improved highways. For instance, the rice industry which sprang up suddenly in the Sacramento Valley after the construction of the highway system brought the paved highways of this district three unseen problems: (1) Excessive motor truck loads; (2) irrigation water standing for months at a time, thereby saturating the sub-base; and (3) alkalis (leached from the soils) that attacked the concrete.

The state law limits loads to a maximum of 800 lb. per inch width of rubber tire, but trucks delivering from the rice fields and from other farming districts, state officials report, frequently operate with 1,000 lb. or more per inch width and often carry 8 tons per load. An effective patrol system for preventing these infractions of the law has not yet been devised.

From the danger of standing irrigation water it has been possible to afford some protection by special drainage ditches along the shoulders.

The question of what should be done to protect the concrete from the action of alkali, however, is still unsolved. This is suggested as a topic on which investigation by the U. S. Bureau of Public Roads would be of great benefit. The use of an asphalt base under the concrete is being planned and where the presence of alkali is suspected particular pains are taken to secure a dense concrete so as to exclude, in so far as possible, the alkali-bearing water. Irrigation of the sort required for rice culture has brought out alkali salts in districts where they did not before appear in injurious quantities, and, in some instances, where their presence was previously unsuspected.

CONCRETE CONSTRUCTION

Probably two-thirds of the concrete placed on the California state highway system consists of a 1:2½:5 mix. In the last two years the standard mix has been changed to 1:2:4 at an additional cost of perhaps $1,000 to $1,500 per mile. A. B. Fletcher, chief engineer of the highway commission, expresses some doubt as to whether the additional strength secured in this mix justifies the added cost, under the circumstances. On concrete bases the California commission has favored a thin asphalt-oil top, about ⅜ in. thick, on the theory that this prevents raveling and by the cushioning effect reduces the shock and impact on the necessarily rigid concrete base. However, little of this "black top" has been placed in recent years since the advance in cost of labor and materials has put it beyond the reach of the commission's funds. The cost in place has increased from 8 or 10 cents to 20 cents per square yard. Under present conditions it is believed that a 1½ to 2-in. asphaltic top may be more economical than this thin top, and the viewpoint of the commission now is that a goodly percentage of the concrete base to be laid under the present schedule should have this thick black top or wearing surface. Where this will be used is a question that will have to be determined by the kind and amount of traffic, foundation conditions and thickness of concrete base.

CONSTRUCTION FEATURES

The black top is not ordinarily used for repairing concrete pavements which have suffered from excessive traffic or from a combination of heavy wear and weakened foundation conditions. The only remedy recommended for this condition is the placing of an additional layer of concrete on top of that already in place. In fact, the commission when referring to the concrete work, is always careful to speak of it as a base rather than as a pavement. It has always been the intention to place an additional thickness of concrete on some of the thin base roads when traffic and financial conditions warranted it.

The black top is used as a latter, additional thickness, however, on certain pavements subjected to an unexpected amount of traffic but which have not been damaged fundamentally. The customary way of placing it in these cases is to build a concrete shoulder, 2½ ft. wide, on each side of the roadway. These project to a height of from 1½ to 2 in. above the roadbed and are topped with a black top, usually a Topeka mix, from 1½ to 2 in. in thickness. This topping extends the full width of the roadway between shoulders. This construction gives a black center with white border strips (the shoulders are not oiled).

The commission is now definitely committed to the practice of using reinforcing steel in all concrete bases, and a minimum concrete thickness of 5 in. The steel is used on the theory that even a slight amount of it will prevent cracks from widening and thus keep cracked slabs from breaking down.

California is believed to be an exception to other states in that its main highway system includes many stretches where there is heavy travel through uninhabited territory. As a result, there is found hard surfacing where the adjacent territory would call for cheaper construction. For example, 40 miles of the Ridge Route between Bakersfield and Los Angeles was without habitation when the route was built, yet this road was made 20 ft. wide and was paved with a concrete base throughout, the materials being hauled to the job 40 miles by motor truck. Most of the main trunk highways have now been built and under the new $40,000,000 bond issue a large amount of the work will be on laterals.

Effect of Freight Rates

Freight rates have considerable effect upon road construction inasmuch as materials have to be hauled long distances by rail. Along the coast from Monterey Bay to Los Angeles, for example, the absence of gravel deposits and commercial rock quarries has necessitated the shipment of crushed rock as far as 200 miles. The present freight charges are approximately three times the pre-war rates, because in those days the state enjoyed special rates on road materials which were about half the normal freight rates. Now, no special rate is allowed. Because of the frequency of long hauls, the policy has always been to make every effort to develop any good local sources of supply. However, deposits of suitable materials near the jobs are comparatively rare in California, and there has been nothing to do but pay the high freight rate.

During the construction season of 1921 slow cement deliveries and car shortages will not be factors, it is believed. Some difficulty was experienced during the past construction season in securing cement, but car shortages and scarcity of labor, the two chief causes, are no longer feared. During the war all available cars were taken from the Western rail lines and it does not appear that the coast supply of cars has been drawn upon since then. Meantime, freight shipments have decreased, so the cars available have been able to handle easily the business that is offered. Unlike the Central and Eastern states, California does not have to give up a large number of cars to assist in the transportation of winter coal supplies.

Day-Labor Construction

A sufficient amount of labor is now available in the state, but the average cost exceeds $5 per 8-hr. day, and during the summer months the better class of labor is attracted to the canneries and orchards. Moreover, under the existing state policy all highway work done on the day-labor plan can be performed only by American citizens. Indirectly, this has increased labor costs on state road work. An average of about 500 convicts is employed in remote districts, and the results of several years' experience with this class of labor have been particularly good. However, the maximum number of convicts available for this kind of work is about 750 to 800. The total cost of feeding, housing, clothing and equipping them is about $2 per day, or less than 40 per cent of the common-labor wage. State highway officials assert that convict labor is far more efficient than the average common labor of today.

California's experience with day-labor work has proved, according to an announcement recently issued by the highway commission, that contract work is the more economical way of carrying on highway construction, and that it can thereby have a greater volume of work under way. Therefore, the commission undertakes work by day labor only when the job is too small to warrant advertising for bids, or when no fair bid is tendered. During the early period of state highway construction, approximately 80 per cent of all work was done by contract. War conditions, with a consequent increase in the prices of materials and wages, influenced the state highway commission to assume more work on a day-labor basis. During the past season work done under contract and by day labor was about equally divided in volume. With resumption of active construction under more normal conditions, the commission hopes to do less day-labor and more contract work.

Though California has experienced many difficulties in pioneer work of concrete roadbuilding and though her problems, herein presented, have called for a measure of resource in solving them, highway engineers all over the country doubtless are more interested in one problem of California's more than any other—the service value of thin-slab, carpet-top concrete roads under intense motor vehicle traffic. That particular question is the subject of inquiries on the part of three organizations referred to in the introductory paragraph of this article. These reports are expected to add greatly to the published data on California's highway practice.

Earthquake Causes Surge in Sewer

THE accompanying diagram taken from records of an automatic gage shows effect of the June 21, 1920, earthquake on the flow in the main outfall sewer of the city of Los Angeles Cal. The record shows the variation in the depth in feet in the sewer, which reaches its maximum each day about noon. At that time on JJune 21 it had reached a height of 4.18 and was steadily decreasing until shortly after 6, when the earthquake occurred. The surge which then resulted is shown by the vertical line reaching from a point 4.37 down to a point 2.82. This was practically instantaneous, as shown on the gage, and apparently had no effect on subsequent flow.

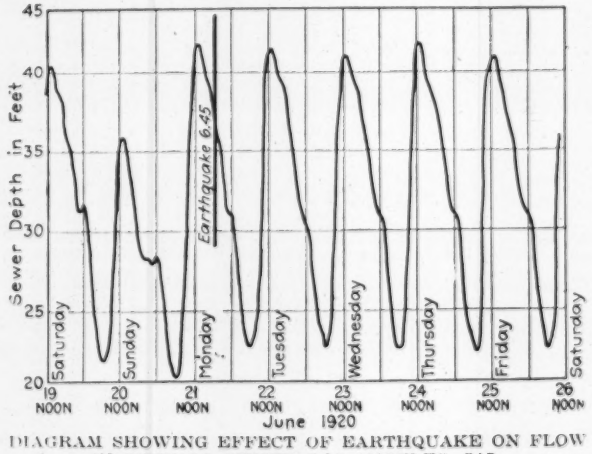


DIAGRAM SHOWING EFFECT OF EARTHQUAKE ON FLOW IN OUTFALL SEWER, LOS ANGELES, CAL.

Assuring Safety in Old Highway Bridges

Bridge Danger Often Exaggerated, But Conscientious Supervision Necessary—What Loading Should Be Provided For—Experience With Failures—Floor Repair

By M. W. Torkelson
Bridge Engineer, Wisconsin Highway Commission, Madison

THE effect of modern highway traffic on existing bridges has of late been the subject of much speculation and in some quarters appears to have caused a very large amount of alarm. The recent progress report of a committee of the American Road Builders Association on this subject opens with the statement "it has been estimated that more than 80 per cent of the highway bridges are a distinct menace due to either of two things, original construction not strong enough for modern traffic demands, or deterioration." While the writer does not wish to belittle such danger as actually exists, he cannot but feel that this statement goes far beyond the facts and is liable to cause unnecessary alarm. He is willing to concede that he is not familiar with conditions in the more densely populated Eastern States, yet his experience does include a metropolitan area, where the loads to be carried are probably as heavy as they are anywhere, though possibly the traffic is not as dense as in certain localities in the East. It is not contended that our bridges are of the strength they should be; it is admitted that some of them are dangerous, but to say that 80 per cent of the bridges are a distinct menace is to make a statement that does not appear to be warranted by the facts. It makes it appear that any man who goes out on the road with a good-sized truck is in danger of losing his life or his property, or both, and suggests that we should make extensive repairs on practically all of our older bridges.

Bridge Problem Not Primary

Reliable statistics are necessary to prove the truth or error of the statement quoted. Records of highway traffic and highway accidents do not, to the writer's knowledge, exist. But experience extending over more than twelve years shows that accidents due to failures of highway bridges, either in whole or in part, form no more than a very small portion of the total number of accidents occurring on the highways. It is true that weak bridges constitute one source of danger; but bad alignment, narrow embankments, railroad grade crossings, lack of enforcement of traffic rules and many other causes of accident which might be cited are far more serious. In the writer's experience during the time quoted he does not know of more than a dozen or fifteen bridge failures in the state. During the same period accidents on the highways due to other causes, resulting in great damage to property and loss of life, have occurred by the hundred. How then can the condition of our highway bridges be held up as a distinct menace? Or, if it is a menace, why should not greater attention be paid to rectifying these other conditions which are much more destructive?

Nevertheless, there is a problem which must be recognized and faced. Provision must be made for motor trucks, which are with us now and which will continue to come in ever-increasing numbers. Where one truck now travels the main road there will in all probability be ten within ten years. The problem is to take care of this truck traffic until such time as all of our old bridges can be replaced with new structures of adequate strength. This does not mean that we should undertake to strengthen all old bridges, or that we should embark on an extensive repair program. Repair work is expensive, and even when repairs are completed the usual result is still an old bridge that nobody wants. If extensive expenditures are incurred they should be for new work.

Live Loads for New and Old Bridges

The individual load for which we will have to provide will probably not be much greater than at present. The law in Wisconsin requires all steel, iron or concrete bridges to be built of sufficient strength to carry safely any load which may be driven or propelled thereon of *not more than 15 tons.* Under the unusually rigid assumptions of the Wisconsin Highway Commission as to distribution of load, the bridges designed under this assumed loading are of ample strength to carry 20-ton tractors. To date the only loads which have approached the limit are the traction engines which are in general use for threshing purposes. These tractors, while not considerable in number, exist throughout the entire state, practically, and almost any bridge is liable to be called on to carry one. Though they travel at slow speeds, not more than 2 or 3 miles per hour, yet they are almost invariably equipped with heavy lugs which cause considerable impact.

The writer does not believe it likely that this weight is going to be exceeded in trucks, except in rare instances. We must consider that there is a reasonable limit to truck weights that must be observed, otherwise we will have a parallel to the well-known competition between the safe manufacturer and the burglar. If the weight of trucks is permitted to be increased to the limit as soon as the roads are surfaced with improved pavements, the weight of trucks will be increased, the pavements will again be inadequate, and the vicious circle will continue. Plainly, this cannot be tolerated. Though heavily laden trucks travel at higher speeds than traction engines they run on smooth rubber tires which, even though solid, tend very much to decrease impact. The tendency of the time is more and more to pneumatic tires, which again will tend to reduce impact. Under the circumstances, the writer is forced more and more to the conclusion that the truck of the future will not greatly exceed in capacity the truck of the present time.

Fixing up our old bridges to last ten or fifteen years longer does not mean that we must spend large amounts for indiscriminate repairs. The extent to which a weak bridge should be repaired will depend very largely upon where it happens to be and what traffic it is called on to carry. If it is located on a byroad where heavy loads pass only at rare intervals, it should remain untouched until all of the bridges in the same class located on the *main roads* are repaired. "Repair," furthermore, does not mean that the bridge should be brought up to the standard of new construction. There

can be no argument about the necessity of first-class design for new work; ample provision for the future should be made. But where the problem is one of caring for traffic for a few years only we need do no better than our everyday experience shows us is necessary to carry the loads.

Facts About Failures

Since the object in mind is the prevention of bridge failures it is important to study just how failures occur. While the writer has no accurate statistics at hand it is his belief that most failures occur only after there have been indications of danger unmistakable to any man who is competent to be in charge of the highway work for a county. In two failures involving fatalities which have come under the writer's observation this was especially noticeable.

In one of these, where the failure occurred through the buckling of a T-chord pony truss, the truss stood for months, badly out of line and steadily getting worse, while carrying a severe load at frequent intervals. The writer personally warned the driver of the tractor under which the bridge later collapsed, in the presence of the town chairman, but the warning went unheeded and after a few more trips the bridge collapsed, killing the driver and his fireman. In another case, where a long single-span bridge fell into the river, the failure was due to the collapse of an improperly built abutment. The deterioration in the masonry had been observed as much as four or five years before the accident occurred, and there had been talk about relaying the masonry and fixing up the bridge. But through the inertia so common in our public officials nothing was ever done.

In other cases, where there have been failures in bridge floors examination after the failure has shown that a majority of the joists was rotten from end to end, the wonder being that they carried even their own weight, to say nothing of heavy loads. This condition could easily have been detected in advance; any experienced construction foreman taking the trouble to look under the bridge floor would have been in a position to detect the danger and to suggest the remedy.

Failures in Steel Bridges

In the writer's experience failure in members of steel bridges are extremely rare; he knows of only four, and fortunately none of these resulted in accident. One, a clean break through a main member consisting of four good-sized angles, occurred during erection. Probably this was due to imperfect metal, all four angles in the member having been cut from the same imperfect section. In another case a lower-chord member in the center panel of a 40-ft. pony truss failed about four years after erection. This was also due, in the writer's belief, to bad metal in the member, but the break was detected and the bridge supported on falsework before any harm resulted. The other two failures were in eyebars with welded heads, clean breaks through the welds. In one of these cases, where the matter was brought to the writer's attention, he was instrumental in getting a new bar installed, the remaining bar carrying the load in the meantime. In the other case the second bar of the pair carried the load over a considerable number of years and no harm resulted.

The failure of trusses as a whole is also very rare. The only cases of failure of this kind of which the writer has knowledge are two or three T-chord pony trusses and the single long truss previously mentioned. But this latter involved no fault of the truss itself; the abutment was built of shapeless igneous rock, laid up with no more natural bond than there would be in a pile of pumpkins, with but very little mortar and that of poor quality. All of the other truss failures of which the writer has knowledge have occurred in unbraced T-chord pony trusses, and in these cases the trusses invariably got badly out of line and remained in this shape for long periods before the truss went down. The incipient buckling was plain warning of coming trouble, but was ignored.

Floor Failures

It also seems that actual failures of steel floor system members are few and far between. In the early days, about 1908, when Wisconsin first interested itself in bridge construction, the writer was frequently called upon by local officials to get up bridge plans and was required to justify these in competition with plans proposed by bridge contractors. In those days the most frequent debate was with reference to the size and number of floor joists. The state department's plans usually called for 9-in. joists where the plans previously in use had specified 6-in. joists. The writer remembers frequent arguments with bridge men with reference to these so-called heavy steel joists, and the statement was made by these men, in good faith, that they had never known of an instance where a steel I-beam had actually broken under a load. There had been some instances where the drive wheels of traction engines had broken through a floor, letting the axle down on the steel joists, but the joists (so it was reported) invariably held. Since that time the writer has heard of only a single case where any rolled steel beam has failed under a load, and that failure occurred in a 10-in. beam in a bridge with 16-ft. roadway. The traction engine causing this failure was said to weigh in the neighborhood of 15 tons; the break was described as a clean, bright break, indicating no flaw.

The writer believes that by far the most usual cause of bridge failures is the failure of wooden floor joists or floor planks. Previous to about 1900 the majority of steel highway bridges were built with timber floor joists and many of these bridges are still in service. These floor joists naturally rot most rapidly on the upper side. It has been frequent practice to turn these old joists, putting their straight side up and leaving the badly rotted side, full of old spike holes, each with the adjacent area badly rotted, on the lower side, where it is called upon to take tension. This procedure makes it possible to lay down the new floor planks on a straight surface, but it certainly does not make the floor any stronger. Many old joists thus remain long after their period of usefulness is over. In the writer's opinion they cause more bridge accidents than all other causes combined.

Floor Repair the First Step

From the foregoing it appears that the most necessary thing to do is to have careful examinations made of our bridge floors and the proper remedies applied to such bad conditions. This applies to short spans as well as the long spans. If the bridge is short, not more than 30 or 40 ft., the problem of repair is simple in nine cases out of ten: throwing out unsound joists and replacing them with joists that are sound. If the trusses are

weak, it is usually possible in these short spans to place supports under the panel points. In timber pile trestles repairs consisting of the replacement of rotten timber are a comparatively simple matter. The deck can be removed, caps taken off, and new piles driven where necessary, without any great skill being required.

In case of a combination timber truss bridge the problem is more serious. There is no type of bridge, in the writer's judgment, so dangerous. Rotten timber may exist in a vital spot undetected, and it is beyond the power of any man to say whether or not an old bridge of this type is safe. But there are instances where such bridges have stood up and carried traffic for years after having sagged appreciably under their own weight, probably due to slight rotting and subsequent crushing of timber at the ends of compression members.

In nine cases out of ten steel bridges, even those built more than 15 years ago, are of ample strength, in so far as the trusses are concerned, to carry modern loading, the weak point usually being the floor system. If the floor joists are of timber a careful examination of them should be made, piece by piece, by an experienced timber man. If a considerable portion of them are in good shape it may be wise to reinforce the floor by replacing the joists which have rotted to a serious extent and to increase their number. In case many of them are in bad shape it probably will be wisest to replace them with steel joists spaced not more than 27 in. between centers and of proper size for the length of panel. Usually the trusses are not of sufficient capacity to carry a reinforced-concrete floor and have any live-load capacity left, but a laminated floor of 2 x 4-in. planks laid edgewise, protected by a bituminous wearing surface, will, if given reasonable maintenance, give service during the remaining life of the bridge. If the floor beams are weak there are ways of reinforcing them. Usually, however, serious weakness, if any exists, will not be in the beam itself, but in its connections. It is a comparatively simple matter to design auxiliary yokes by which these end connections can be reinforced and the capacity of the beam itself thus be greatly increased.

Sometimes there is serious corrosion in certain members of the bridge at the floor line. Usually this condition is worst in the end posts, but sometimes it is present in the web members, and the writer has seen it even in the lower chords. If serious corrosion exists near the end of any member the repair is usually a serious matter, involving supporting the bridge on falsework and replacing the corroded member. But if the corrision is a sufficient distance away from the end connections to give grip to the splice it is usually possible to design a splice reinforcement to the corroded member which will give the bridge its original strength and which can be installed without interrupting traffic.

Dealing With Weak Trusses

To attempt to strengthen the trusses of steel bridges is usually useless. The expense is generally great and the result a patched-up old bridge which is not worth what it costs. It would be better in a majority of cases to scrap the old bridge and build a new one. If the span is short or obstruction to the stream not serious it may be possible to introduce supports under the panel points, in effect converting the bridge into a trestle. This procedure also is relatively expensive, and it would be better in a majority of cases to apply the money toward the construction of a new bridge.

Much unnecessary loading is put on highway bridges through impact caused by improper approaches and rough bridge floors. Just so sure as a rough bridge floor will cause a large amount of shock, stressing the bridge far beyond a static load of the same weight, so will removing the causes of impact tend to relieve the bridge. The laminated 2 x 4-in. floor protected with a bituminous wearing surface, heretofore referred to, can be made so smooth that loads will roll across with little if any impact, and the approaches to any bridge can be placed in such condition that the loads will roll upon the bridge smoothly and not, as is often the case, land on it with a bang that can be heard half a mile away.

The writer's program can be summed up in a few words: Find the really bad places and make them safe. This does not mean the repair or reinforcement of all old bridges indiscriminately, but the searching out of those glaringly bad places so plain to be seen once looked for, which cause nine-tenths of our failures, and the replacement of rotten materials with sound materials where this will result in a reasonably adequate structure. Where reasonable repairs will not result in substantial improvement a new structure should be built. Where a structure gives plain signs of distress these should be heeded promptly, not ignored. Experience shows that if this is done bridge accidents will practically disappear.

But this requires eternal vigilance. There must be someone on the job whose business it is to look out for these warnings and apply the remedy without delay. We must act, not procrastinate.

In Wisconsin the supervision of all bridges on the state trunk highway system is in the hands of the county highway commissioner, who is directly in charge of all county construction and maintenance. He in turn is under the direction of the state highway commission, which is authorized by law to require the reconstruction of any bridge or culvert deemed dangerous. It is a portion of the county highway commission's engineers on maintenance work to make frequent examinations of all drainage structures, and to recommend and cause to be executed such repairs and betterments as may be deemed advisable. The state highway commission has received very loyal support from the county officers, and through their co-operation more than a thousand of the worst structures are being replaced yearly with permanent structures of high type. At the present rate of accomplishment we expect to keep ahead of our traffic problem, keep bridge failures down to a minimum and have all of our seriously weak bridges on important routes replaced in ten years with adequate modern structures.

Cement and Base Metals Now Lead

Speaking at a recent meeting of the Portland Cement Association Dr. George Otis Smith, director of the U. S. Geological Survey, said:

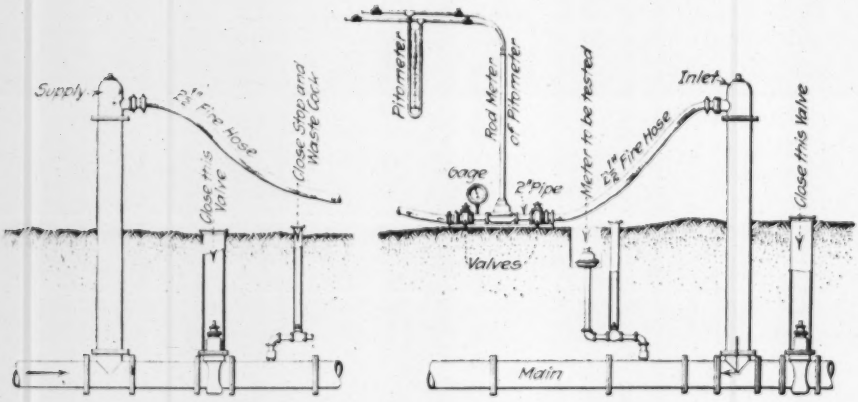
We are apt not to pay enough honor to the humble but useful things of life. The dominant position of our country in a world of industry and commerce is due largely to our wealth in the essential minerals, and the statistical record of the growth of our mineral industry shows how the baser metals have taken the leadership from gold and silver. Indeed the non-metals, once of subordinate rank, now far exceed the metals in value of annual output.

Test of Large Water Meters in Place With a Pitometer

By Frank D. Danielson
Assistant Engineer, Village of Glencoe, Ill.

When service meters have measured about 400,000 cu.ft. they usually under register and must be removed for testing and repair. Meters up to and including the 2-in. size may be removed readily and checked for accuracy at the shop, but larger meters are heavy and it is often impracticable to remove them from their setting in vaults. For testing large meters in place at Glencoe, Ill., a pitometer was used as shown by the sketch.

The pitometer was set up near the vault containing the meter to be tested. The rod meter of the pitometer was inserted through a corporation cock on a 2-in. galvanized-iron pipe about 6 ft. long. A valve attached to the pipe on each side of the pitometer assisted in the control of the water while the apparatus was being placed. To each end of the 2-in. pipe was attached a length of fire hose which reached to neighboring hydrants.



PITOMETER SET-UP FOR TESTING LARGE METER IN PLACE

For such use of the pitometer and fire hose, instead of tapping the main, the location of hydrants and valves must conform to certain conditions. Sometimes it became necessary to connect hydrants which were located more than a block away from each other. The losses occurring in such extended hose lines together with that from the mains included was first determined as stated later. One hydrant must serve as the source of water supply and the other as the inlet to a section closed off in the street main from which the meter to be tested is fed. This closed-off section is easily obtained by shutting one valve anywhere between the supply hydrant and the service pipe to the large meter and another valve back of the inlet hydrant. All stop and waste cocks on service pipes leading from the segregated section of the main street must also be closed, except the cock to which the meter to be tested is attached. The pipe to which the meter under consideration is attached must be closed in the residence served. The lawn faucet can then be opened to allow a stream to pass which has been measured both by the meter and pitometer.

The water measured was fed from the supply hydrant through the pipe containing the pitometer orifices into the inlet hydrant to the segregated section. The loss in the system which must be credited to the meter when comparing its discharge to that of the pitometer had to be determined. To do this the stop and waste cock near the meter under investigation was closed and a reading of the deflection of the manometer taken. If there was no waste the deflection was zero, since all flow past the pitometer orifices had been stopped. If a slight deflection in the U-tube was shown the computed discharge was added to the meter reading to give the net discharge.

Before starting to make meter and pitometer readings water was allowed to pass through the set-up for a short time to assure the proper working of the whole system. When the pressure gage attached to the pipe near the pitometer showed a constant reading the flow was considered uniform. Time was taken for the passage of a definite volume of water through the meter. When the indicator of the 1-cu.ft. dial read zero, the time was recorded and a reading made on the manometer. The flow continued until the prescribed number of cubic feet had passed through the meter, when the time was again noted. During this interval the U-tube deflection was read frequently and the mean taken in computing the velocity of flow and the discharge. Comparative discharge determinations were made with several different-sized streams flowing from the lawn faucet.

Having determined the amount which a meter registered either above or under (the former was never found) 100 per cent, the following formula may be used for finding the correct change gears:

Ratio of required gears equals $(A \times R)/(B \times 100)$, in which A equals number of teeth in gear on register spindle, B equals number of teeth in gear on stuffing box spindle, R equals per cent registered with above gears. Tables from the meter companies are available which give the ratio and diameters of change gears.

From the work carried on in Glencoe the writer feels confident that a high degree of precision in testing large meters with a pitometer can be easily attained.

Engineer Salaries

From a wide variety of sources covering the entire country the averages of engineering salaries as reported in the *Professional Engineer*, the official publication of the American Association of Engineers are as follows: Tracers, $150 a month; detailers, structural, mechanical and electrical, $185 to $210 (a few companies pay up to $230 a month for experienced men); designers on all classes of work, $250 to $300 a month; estimators and checkers, $300 to $350 a month; rodmen and levelmen, $150 to $180 a month; instrumentmen, $175 to $250 a month; assistant engineers, $200 or more; map draftsmen, $200 a month; surveyors, $175 to $200 a month; research engineers, $200 to $300 a month. The salaries vary somewhat depending upon class of work and location of the position, on which depends cost of living. Temporary positions average 25 per cent more than permanent position.

Alternative Outlets for Sewage Pumping Station

Gravity Flow to River—Pumping to River or to Sewer—High and Low-Level Conduits to Junction Chambers

COMPLICATED sewer outlet connections are required at the new Calumet sewage pumping station of the Sanitary District of Chicago, owing to the provision of alternative means of discharge for both dry-weather and storm-water flow. Thus the flow may be diverted west to the high-level Calumet outfall sewer connecting with the Calumet-Sag drainage channel, or south to a low-level emergency outfall leading to the Calumet River.

Both sewage and storm water will enter the north end of the pumping station by a large sewer of horseshoe section 17½ ft. wide and 14 ft. high, and after passing through a screen chamber will enter the basement of the station, which forms the suction chamber, as described in *Engineering News-Record* Nov. 4, 1920, p. 872. A depressed portion of one side of the floor forms a channel for dry-weather flow. Electrically-driven centrifugal pumps discharge into a storm-water basin on the west and a dry-weather basin on the east side of the station.

Two double-barrel conduits lead from the side and end of the storm-water basin to junction chambers at the heads of the Calumet sewer and the river connection respectively, as shown in Fig. 2. The curves are made with a radius of 46 ft. on the center line between the conduits. Two single conduits lead from the end of the dry-weather basin to the same junction chambers, but entering these chambers at a lower level. One of the conduits is straight, except at the connection to the junction chamber, while the longer one has curves of 12 ft. radius. The plan and profile of these four conduits are shown in Fig. 2.

A horseshoe section is employed for all conduits, 8 x 8 ft. for storm water and 7 x 7 ft. for the dry-weather flow. Two interesting features are the double-deck junction chambers and the intersection of the single and double-barrel conduits. From the details of the Calumet sewer junction chamber, Fig. 1, it will be seen that a reinforced concrete monolithic structure some 70 ft. long, 24 ft. wide and 28½ ft. deep includes the chamber with its curved double-barrel connection at the upper level and its straight single-barrel connection at the lower level. Provision is made for stop planks to close the ends of the three conduits.

Hydraulically-operated sluice gates in the discharge basins at the pumping station will control the direction of flow in the several conduits. Each basin will have

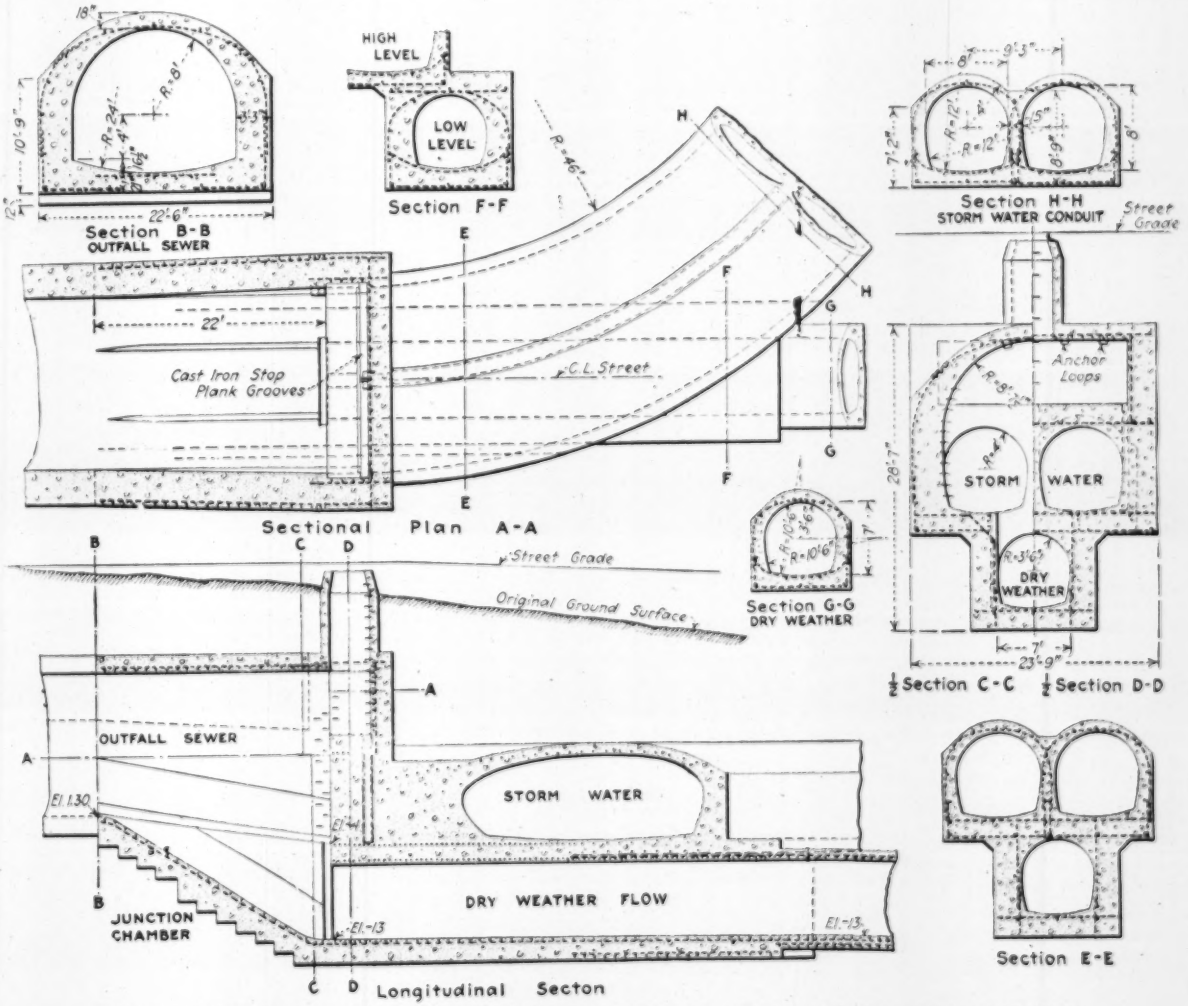


FIG. 3. DOUBLE-DECK JUNCTION CHAMBER AT OUTLET OF HIGH AND LOW-LEVEL CONDUITS

gates at the discharge conduits and at openings connecting with the suction chamber, so that when the river is low a gravity flow can be maintained through the station. When the river is high, the gates to the suction chamber will be closed and the sewage pumped then to the high-level or low-level discharge conduits, as may be desirable.

These outlet connections and the substructure of the pumping station were designed by S. T. Smetters, assistant bridge engineer of the Sanitary District of Chicago, under the direction of C. R. Dart, bridge engineer, and E. J. Kelly, chief engineer.

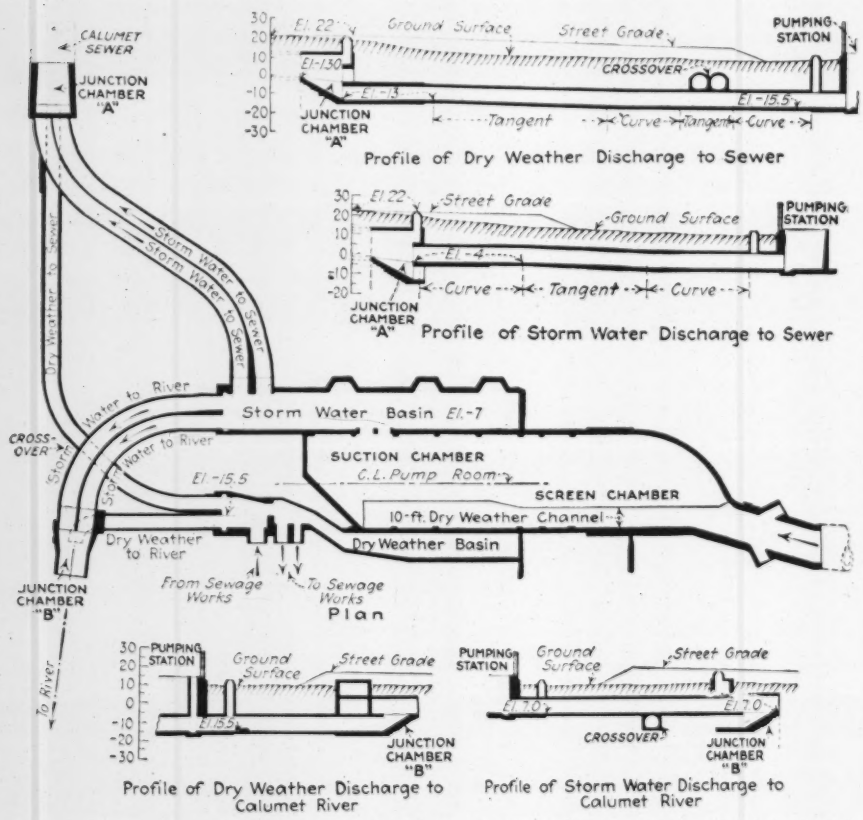


FIG. 2. SEWAGE PUMPING STATION WITH ALTERNATIVE MEANS OF DISCHARGE

Neighborhood Group Plan for Cleveland

A neighborhood center and group plan for the Brooklyn section of Cleveland, Ohio, has been tentatively approved by the City Plan Commission of Cleveland. This is described as "the second link in a chain of community or civic centers proposed for various localities in Cleveland" which are designed "to perform the same service for local communities as the downtown group plan does for all Cleveland." The Brooklyn neighborhood center "calls for two rather massive buildings, one on either side of Pearl Road at the southerly end of the Brooklyn-Brighton bridge overlooking Big Creek Valley." There would be landscape development between and near the center and some street widening is proposed. The community center plans for Cleveland are being worked out by Robert H. Whitten and Frank R. Walker, advisors of the City Plan Commission.

Employment Service of A. A. E.

By E. B. Miller

Assistant Secretary in Charge of Employment Service, American Association of Engineers

FOR the eleven months of 1920 ending Nov. 30, the employment department of the American Association of Engineers was instrumental in placing 2,970 men in new positions at an aggregate annual salary of over seven million dollars. There were 7,000 openings received to which 31,000 men were referred. If this service were rendered by professional agencies the fees paid would have amounted to about one-third of a million dollars.

During November 717 vacancies were received to which 3,506 men were referred and 312 men placed. The greatest demand for the month was for engineers in the industries, that is, mechanical engineers, mechanical draughtsmen, production managers and industrial engineers. The least demand was for construction engineers, superintendents of construction and general civil engineers. This showing was natural because little construction has been in progress for several months. Recession and hesitation in business are becoming more prominent daily; as a result, the number of technical men out of employment is increasing. The condition is not, however, alarming as it has been manifest in practically all preceding years of record, since there generally is a year-end pause. A resumption of activity in the engineering field normally comes about quickly after the first of January. Indications are that considerable construction will be under way soon and that exceedingly favorable conditions are ahead.

SERVICE RECORD FOR NOVEMBER, 1920

	Positions Received		Men Referred		Men Placed		Applicants for Employment	
National office		483		2,944		179		1,382
Chicago	42		126		25		138	
Twin Cities	30		69		31		40	
Pittsburgh	7		15		0		10	
Seattle	13		42		6		15	
Detroit	3		4		2		7	
New York	53		112		26		75	
El Paso	16		28		10		20	
Washington	8		13		6		5	
San Francisco	10		20		2		5	
Chattanooga	6		12		1		4	
Los Angeles	33		70		14		36	
Philadelphia	4		12		0		6	
Portland	14		30		8		15	
Toledo	5	244	9	562	2	133	5	381
Total November		717		3,506		312		1,763
Total Oct.		694		3,357		301		1,602
Total Nov. 1919		400		1,490		145		470

The average salary, $201, is $2 less than last month. The total monthly salary of all positions filled was more than $63,000, with a saving to members, if commercial agencies rendered this service, of $37,000.

One of the features of the employment service is the

monthly review of engineering conditions through which a classification of salaries is made for different positions in different localities both of men available and men wanted.

Horizontal Diaphragm Increases Surge Tank Capacity

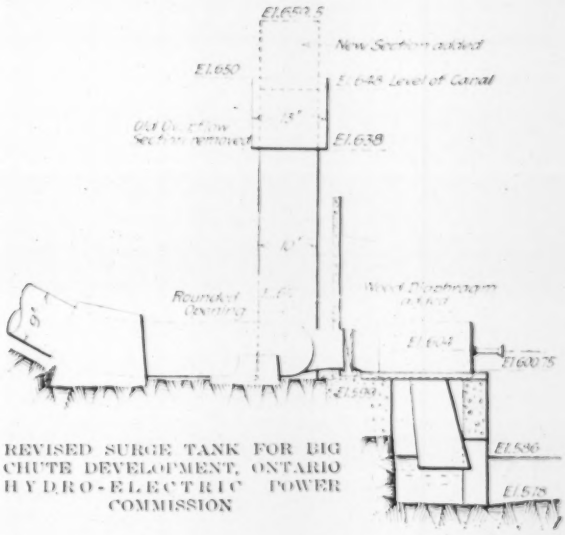
Added Penstock Threatened To Overtop Tank, but Surge Is Throttled Down by Plate With Small Opening

IN ADDING to the capacity of a small hydro-electric power station at Big Chute, Ont., the Hydro-Electric Power Commission of Ontario has saved considerable time and money in the surge tank reconstruction by adding a horizontal diaphragm to throttle down the surge rather than to build the tank high enough to take the unrestricted flow. The original installation of the plant consisted of three 1,100 hp. units supplied by a 9 ft. diameter penstock 100 ft. long. A second penstock of the same size was added to supply a new unit of 2,300 hp. and was also connected to the first penstock. Some provision obviously had to be made for the regulation of the water column in the penstock for loads thrown off the plant.

In the original development the surge tank was 10 ft. in diameter, with its top at El. 650 or 2 ft. above canal water level. In addition to the 51 ft. straight shaft there was an upper 12 ft. section 13 ft. diameter for overflow and provided with a 10-in. drain leading to the tailwater. Even under the old load conditions it was found as the load on the plant approached full capacity that spilling from the tank occurred for full-load shut down.

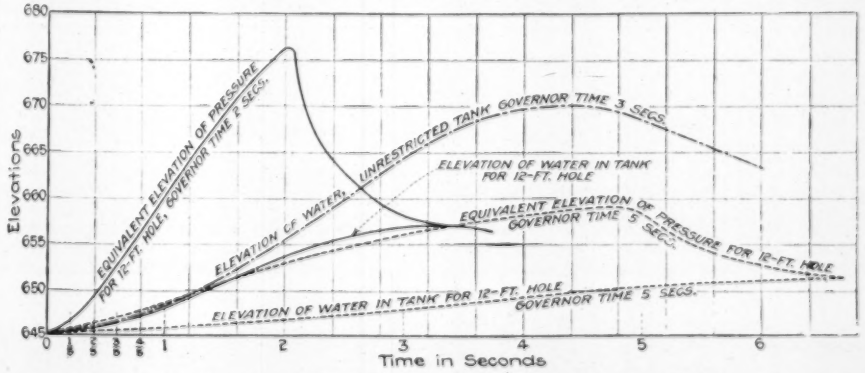
Studies were then made to determine the best means of caring for the extra surge when the new load was added. First a calculation was made to find the elevation to which it would be necessary to carry the 10-ft. diameter tank in order to prevent any spill-over for full load drop. The governors were assumed to close the turbine gates in three seconds. The result of this calculation is shown on the accompanying diagram with water levels plotted against time. It is seen that the water would rise to El. 670.1 and the tank would have to be carried beyond this elevation to prevent spilling.

Calculations were then made to determine the effect of blocking up the tank, either totally or partly. It was found that if the tank was entirely closed off that for governor time of two seconds, or less, the pressure rise in the pipe line and wheel cases was prohibitive and, of course, there was no rise of water level in the tank. For partial blocking of the tank less pressure rise would result but a rise in the water level would occur. After several calculations it was found that if the tank were partially blocked, leaving an opening with a net area (gross area multiplied by coefficient of discharge) of 12 sq.ft. that a pressure rise quite within safety of the penstock and steel casing would occur and that the water level would rise only a small amount of the rise occurring for a tank with no restrictions. The results of the calculation for this condition for governor closing times of two and five seconds are also shown on the diagram.



REVISED SURGE TANK FOR BIG CHUTE DEVELOPMENT, ONTARIO HYDRO-ELECTRIC POWER COMMISSION

The necessary changes were then made to fulfill this condition. The tank was raised 11.5 ft. to El. 659.5, the plates from the original 13 ft. diameter overflow section being used, and the restricted opening was made by inserting a wooden bulkhead in the tank at El. 612.0. This bulkhead was 12 in. thick and had an opening 18 in. x 8 ft 10½ in. in plan, which with the rounded openings shown made an effective opening of 12 sq.ft. With this device the rise in the tank is kept well below the top and the back pressure in the pipe line within safe limits.



THEORETICAL RISE IN SURGE TANK UNDER DIFFERENT GOVERNOR TIME CONDITIONS

British Road Work Aids Unemployed

New road construction amounting to almost £1,500,000 has been undertaken by various British cities in co-operation with the government as a means of providing work for the unemployed. Details of the plan received from its English information service by the Bankers' Trust Co., of New York, indicates that the British Ministry of Transport will bear 50 per cent of the cost of such work and will loan to municipalities the remaining amount for five years, repayable in annual instalments. Ex-service men receive preference among applicants for employment at the road work but all are required to submit to one week's registration.

State Road Survey Methods and Costs in Missouri

Work on 6,000-Mi. Program by State and Private Engineers—Field Methods—Maps and Plans—Progress and Cost

BY SKILLFUL co-ordination of work done by state forces, by contracts with local surveyors and by agreements with county engineers, the Missouri State Highway Department is keeping the cost of surveying its 6,000-mi. road system within the $100 per mile prescribed by law. This cost includes complete plans as well as field work, the latter now averaging about $60 and the former $25 to $30 per mile. Beginning in 1919, surveys of 4,072 mi. had been completed by August, 1920, and arrangements made for surveys of 856 mi. more.

A Missouri road law which became effective in March, 1919, provided for a state highway system of 6,000 mi. and required that a survey of the entire system should be made within three years. The law authorizes the state highway engineer to have surveys, plans and estimates made either by his own forces or under contract with private engineers and surveyors, the cost of contract work not to exceed an average of $100 per mile and to be deducted from the state-aid allowance of $1,200 per mile to the counties. The state highway engineer may also accept surveys, plans and estimates (complying with state and federal requirements) which have been made by county engineers or other local authorities without cost to the state, in which case no deduction is made from the $1,200 per mile.

All of these methods are being employed in order to have the program completed within three years. To carry out the work of the highway department effectively the state was divided into six divisions, each under the charge of a division engineer whose duty it is to confer with the local authorities, view and lay out state roads, and supervise surveys and construction.

Surveys by State Engineers

Six survey parties, one in each division, were organized by the department in 1919, each party reporting to the division engineer and to the chief of surveys and plans. These parties were in the field from Aug. 1 to Dec. 1, 1919, and resumed the field work on May 1, 1920. A party is made up as follows, each member being paid the salary noted and allowed subsistence in addition: Chief of party ($160 per month), draftsman ($130), transitman ($125), levelman ($110), head chainman ($80), rodman ($80) and truck driver ($75). The rear chainman, axman and stakeman are hired locally and are paid at the local rate, varying from $3 to $4.50 per day. The above organization is varied according to local demands and efficiency. In open country a recorder is added to the party and sometimes it is necessary to operate two level parties.

The chief of party is responsible for the work, obtains subsistence, handles the payroll and expenses and reports progress weekly on a postcard form, shown herewith, to the division engineer and to the chief of surveys and plans. He presents a monthly report on salary and expenses. Instructions as to the route he is to survey are received from the division engineer. Questions of organization and operation of the parties are taken up with the chief of surveys and plans.

The draftsman keeps the alignment and profile notes plotted to date in pencil, inking the plans only when he has caught up with the transit and profile parties. This allows the chief of party to inspect his work and to check the field data daily. The transitman takes all notes that might affect the planning of the road with reference to alignment and drainage. The "lining in" of the chainman is performed usually by the truck driver, who is instructed in the rudiments of handling a transit; he also brings the instruments forward and provides the back sight, using the truck for conveyance. The levelman sets bench marks and runs profiles and cross-sections. In level country the addition of a recorder to a level party has often increased the volume of work over 25 per cent.

The party lives in towns along the routes. It is equipped with a motor truck for conveyance, a light transit, two range poles, two 100-ft. steel chains, one set of pins, one tape repair outfit, one level, two level rods, three 50-ft. metallic tapes, one field chest, two collapsible drawing tables and other supplies for field and office work.

With this organization the average field work is from 1 to 1½ mi. per day. From May 1 to Aug. 1, 1920, the average was 30 mi. per month per party. In 1919 the parties did not equal these averages, as they were newly organized and many of the men had had little experience. Six miles is the maximum transit line that has been run per day. Four miles is the highest record of cross-sections, these sections being taken at each station and oftener. For the completion of the plans the state highway department maintains a small organization at headquarters throughout the year and brings in certain members of the field parties during the winter.

Independent Surveys for State Roads

Contracts with private firms stipulate that they are to make the survey, prepare plans and estimates, provide five sets of blueprints, and upon approval of the plans to deliver all the original tracings and field books, for a stipulated price per mile not exceeding $100. The contracts provide for partial payment as the work progresses. For a small mileage where the work is easy, survey contracts have been let as low as $85 per mile. In several places where the survey is difficult and where the contractor's price is more than $100, the local authorities pay the additional cost, which ranges from $10 to $25 per mile.

County courts, special road districts or other local authorities often enter into contracts with private firms for the survey of state roads. In many instances also the county highway engineer makes such surveys and plans without cost to the state. All such work, however, must be done in accordance with the requirements of the state highway department and the U. S. Bureau of Public Roads.

Under all these independent methods of making surveys, the persons in direct charge of the work report to the division engineer. He accompanies them over the route before the survey is started, shows them the relocations that are desired and outlines to them the manner in which he thinks problems should be attacked. He also provides them with the instructions for making surveys and preparing plans, as issued by the department. These embody and enlarge upon the points covered by the regulations of the Bureau of Public

Roads. He furnishes also a set of Missouri standard specifications and standard culvert and bridge designs, besides giving information as to the type of road contemplated. Contracting engineers report their progress to the division engineer, who in return reports monthly to the chief of surveys and plans.

Character of Road Surveys

A location survey is made in the field, preliminary lines and paper locations not being accepted. All curves are run in on the ground, thus avoiding many equations of stationing. The transit party locates the center line of the proposed road, rounding all corners to a minimum radius of 150 ft., locating topographical features, fences, telephone and power poles, rock outcrops, streams, culverts, bridges and drainage. Notes are made of drainage areas, property owners and other information useful in making an engineering study of the road. This transit line is required to be so made that it can be followed readily during construction. All points of intersection are referenced and as many land ties as possible, the latter to allow of right-of-way descriptions. In general the surveys follow the existing roads, but relocations are made to avoid heavy grades, railway crossings, unnecessary drainage and crooked alignment.

The level parties are required to set bench marks at each ½-mi., to take cross-sections at every station and as much oftener as the breaks in the ground demand, paying particular attention to the elevation of rock outcrops, bridge floors and flow line of streams. Cross-sections are taken for at least 20 ft. each side of the center line and to a greater distance where necessary. These cross-sections are taken with a wye or dumpy level, the distances from the center line being measured with a tape.

Exceptions to the above methods are made occasionally when the survey is an entire relocation in very rough country, as in the mountainous district of the state. On bridges of over a 10-ft. span a survey is made of the site and furnished to the bridge department with a report on standard form. The field parties are instructed to determine the size of openings for drainage structures in the field, choosing the state standard to be used. For larger bridges, they take all high water marks and obtain as much information as possible concerning the present structures. They also estimate the drainage area carefully, in which work the U. S. Geological Survey maps are valuable and are made use of when possible.

Maps and Plans

All plans conform with the requirements of the U. S. Bureau of Public Roads, including the use of 22 x 26-in. sheets showing the road section, plan, profile, cross-sections and special details of construction. For plans the scale is 1 in. to 100 ft. For profiles the horizontal scale is 1 in. to 100 ft. and the vertical scale 1 in. to 10 ft. Drainage structures are drawn on the cross-section, so that their lengths may be determined. Sections of the proposed road are drawn at the correct elevation on the cross-sections and the areas of cut and fill are given at each section, the yardage being given between sections. Details of construction are given on all special structures for which there are no state standards. The department endeavors to obtain plans that are complete in every respect for construction purposes, so that accurate estimates of the work can be made. It endeavors also to give as much information as possible that may be valuable to the contractor.

MISSOURI STATE HIGHWAY DEPARTMENT
SURVEY REPORT FOR THE WEEK

ENDING 19

	Station	to	Station
Transit line			
Level line			
Cross section			
Plats platted			
Profile plat			
Cross section			
Bridge survey			
Remarks			

Chief of Party

POST CARD REPORT FOR SURVEY PARTY

Upon completion the plans are submitted to the division engineer, who makes a field check, particularly as to the locations and sizes of drainage structures, the grade line and location of the road, and the accuracy of the survey, requiring such changes and corrections as may be necessary. The plans are then sent to the office of the chief of surveys and plans, where a thorough check is made of the computations, the completeness of information, the estimate, and as to whether all the work called for in the estimate is shown on the plans. Particular attention is given to guarding against conflicting information. All the errors found are noted, with the changes asked for by the division engineer, and are furnished to the person preparing the plans so that proper revision can be made.

Progress and Cost of Surveys

By the use of the foregoing methods the state highway department has been able to make considerable progress. Prior to 1919 there were surveys of 379 mi. of roads that were incorporated in this state highway system by the present law. On Jan. 1, 1920, some 2,538 mi. of survey had been started, of which 2,141 mi. were surveyed, leaving a net of 1,761 mi. surveyed in 1919. On Aug. 1, 1920, the department had arranged for the survey of 4,928 mi. and had surveyed 4,072 mi., and complete plans for 1,731 mi. had been submitted. Of this total mileage under survey 1,872 mi. were covered by state contract, 1,299 mi. by state parties and 1,756 mi. by county contracts. Of the completed surveys, 1,421 mi. were made by state contract, 1,208 mi. by state parties and 1,501 mi. by county contracts. Of the plans submitted to the department, 551 mi. were prepared under state contract, 487 mi. by state parties and 693 mi. by county contract.

According to official information the cost of making surveys and preparing plans by state parties will not exceed $100 per mile. In 1919 the field work averaged $82.77 per mile, but the cost of completing the plans

made the total slightly over $100. The 1920 field work is costing about $60 per mile. As the cost for completing plans is between $25 and $30 per mile the total cost of the 1920 work will be less than $100 and will thus eliminate the deficiency incurred in 1919. All survey work, as well as road construction and maintenance, is under the direction of Alexander W. Graham, state highway engineer, and C. W. Brown, first assistant engineer. James R. Hancock is chief of surveys and plans.

Modified Vicat Apparatus for Study of Setting Time of Cement

By O. L. Moore
Chief Cement Inspector, Universal Portland Cement Company

For a closer study of the setting properties of Portland cement than is usually necessary in commercial testing it is desirable to have a series of readings taken at short-time intervals while the cement is setting. Such data may be studied as setting-time curves and in investigational work have an advantage over the usual initial and final setting-time data.

In order to obtain data of this nature relative to the effect of temperature, humidity, personal equation, etc., on our inter-laboratory test results we remodelled an old Vicat apparatus, shown in the accompanying cut. After some experimentation and changes in the apparatus quite consistent results are obtained, and we have been enabled to develop some interesting and instructive data in connection with the setting of cement. The principle consists in balancing the rod and needle by means of a beam and weight and determining the load necessary at time intervals to cause the needle to penetrate a definite distance into the neat paste.

The paste, prepared according to the standard methods of the American Society for Testing Materials in a Vicat mold, is placed on the platform, the needle brought in contact with the surface and the stop set for a ¾-in. penetration. Shot or preferably weights are added to the pan until the needle is brought to rest

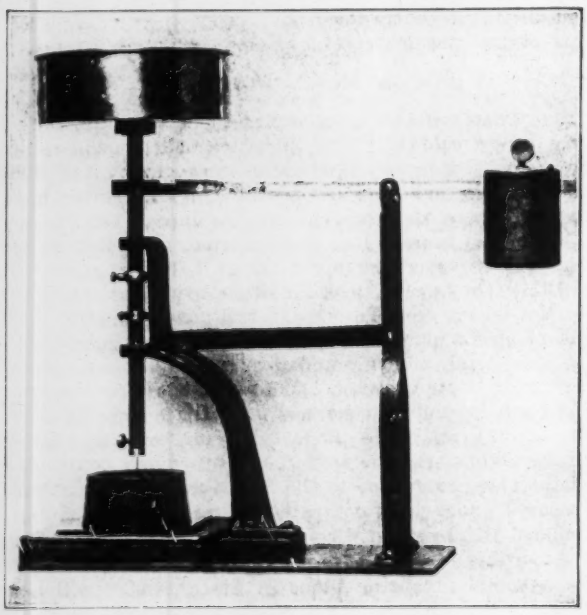


FIG. 1. SETTING-TIME APPARATUS

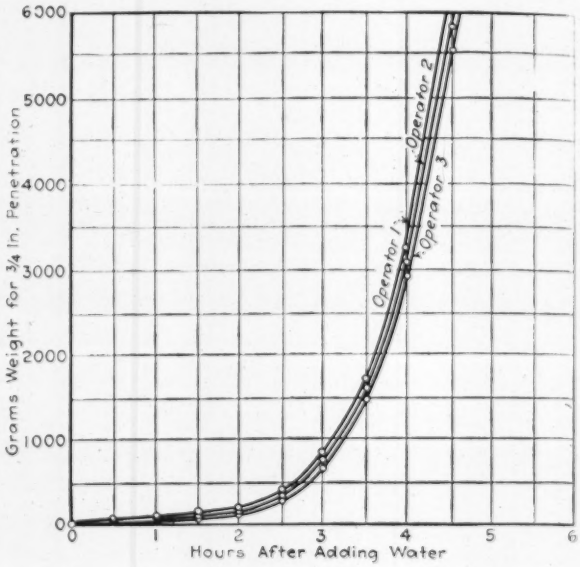


FIG. 2. EFFECT OF PERSONAL EQUATION ON SETTING TIME

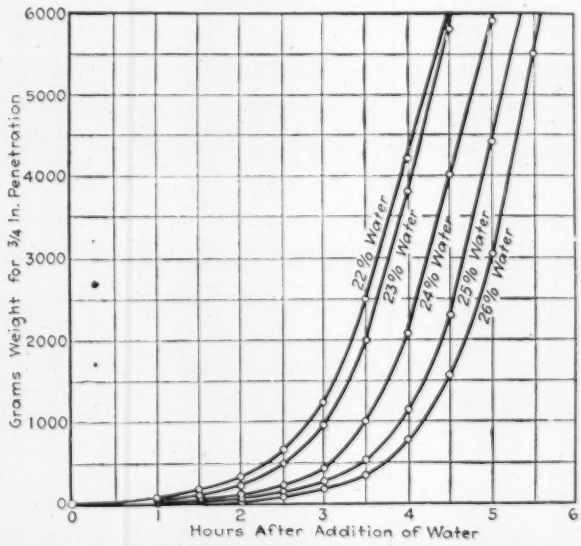


FIG. 3. ADDED PER CENT OF WATER INCREASES SETTING TIME

by the stop. The time and load is then recorded and the specimen returned to the moist cabinet until another reading is desired. Short penetrations give smoother curves than deep penetrations. For normally setting cement hourly readings are sufficient. The load may be applied in units of 50 gr. for plotting on small scales, and reaches the strength limit of the ordinary length of Vicat needle at about seven kilograms.

The accompanying charts have been selected as typical setting-time curves. They give some idea of the consistency of the data and the results which may be obtained with a little experience.

A Reminder of Old Times

The latest published report of the Water Department of Springfield, Mass., records the payment during the year of nearly $200,000 of 3½ per cent water bonds.

Belgian Standard Specification For Structural Steelwork

New Standards Association Has Adopted Draft Prepared by Structural Engineers For Home and Export Use

SPECIFICATIONS for design and fabrication of steelwork for buildings and miscellaneous steel structures were adopted by the Belgian Standards Association a few months ago by the approval of a draft specification prepared by the Fédération des Constructeurs de Belgique, in the course of studies carried out during 1916-1919. This specification, intended to control future structural work in Belgium for both home and export work, with the exclusion only of bridges, is published in the semi-monthly *Revue Universelle des Mines* of Nov. 1, 1920. It is of unusual interest for purposes of comparison with American practice and current specifications. An abstract of some of the leading provisions of the new Belgian standard is given in the following.

According to an introductory statement in the source quoted the object in framing the new specification was not to introduce innovations, but rather to express present-day Belgian practice, yet at the same time to favor maximum economy in construction in view of the high cost of materials. The effort toward economy appears in high working stresses, but safety has been assured in even greater degree by the reduction formulas adopted and by definite provisions for the design of latticed compression members, as also of details of construction in general, it is stated.

Snow, Wind and Live Loads

Snow is to be taken at 7 to 13 lb. per sq. ft. depending on altitude (from sea level to 2,300 ft. elevation). It may be disregarded for roof slopes of 50 degrees and over except where roof valleys hold snow.

Wind loads are to be based on a standard pressure of 20 lb. per sq.ft. (21 lb. within six miles of the coast), 41 lb. for general export, 51 lb. for tropical countries and 62 lb. for the most exposed locations, as the Indian Ocean, the Philippines and the Carolines. Normal pressure on inclined surfaces is $p_A = p_0 \sin^2 (A + 10°)$, but the basal pressure p_o is computed from the standard figures previously given by applying to roofs the factor 0.6 for combination with snow, to walls the factor 0.5 for 50-ft. height, 0.75 for 50 to 66 ft. height, 1.0 for 66 to 82 ft. height, and 1.25 for heights above 82 ft.; 1.25 is to be used for walls of all heights in open country; in all cases the co-efficient 1.25 is reduced to 1.0 when truss and column are treated as a rigid frame. For monitors and for roofs resting on walls an uplift of 0.7 times the standard pressure shall be assumed.

Snow and wind loads may be reduced 20 per cent when considered in combination with other moving live-loads (as crane loads).

Floor loads ordinarily are to be assumed as 41 lb. per sq.ft. for dwellings, 62 lb. for offices, 82 lb. for public buildings, 25 lb. for flat roofs and for industrial use according to conditions. Where a structural element is loaded by two, three, four or more floors superimposed these shall be counted only at 90, 85, 80, etc., per cent of full value, but the maximum reduction shall be 50 per cent (this clause is stated to be taken from American practice).

Working stresses for structural steel are expressed in a form adapted to tension, bending and compression. For tension and bending they apply to net sections (rivet-hole deduction equal to rivet diameter), and for compression to "reduced" areas defined later. The values fixed are: 17,000 lb. per sq.in. in general, 14,200 for crane girders and crane girder columns, and 20,000 for minor framing of brick walls and gables. For shear 80 per cent of these values is to be taken. The figures apply to ordinary soft steel of 52,000 to 62,000 lb. ultimate and 20 per cent elongation, and may be increased for higher-strength metal.

For bolts and rivets (extra soft steel, minimum 51,000 lb. ultimate and 24 per cent elongation), shear may be taken at four-fifths the allowable stress for the connected parts, and bearing at two and a half times the shear. Tension on rivets and bolts is allowable at the stress figure fixed for shear; bolt tension is figured on *gross* section.

Cast iron may be stressed to 2,100 lb. per sq.in. in direct tension, 11,300 lb. (reduced) in direct compression, 4,950 lb. tension in bending and 9,900 lb. compression in bending. Wood may be stressed to 850 lb. in tension or compression with the grain, and 140 lb. in shear along the grain.

Compression Members

Compression members of solid-web section are to be proportioned for the basic unit stress applied to a section determined by reducing the gross section in the ratio of the ultimate column strength to 52,000 lb. per sq.in. The ultimate column strength is to be taken equal to 52,000 for length-ratio (l/r) less than 10; from the formula $44{,}000 - 162\ l/r$ for length-ratio between 10 and 105; and for greater length-ratios from the formula $300{,}000{,}000 \div (l/r)^2$. For combined compression and bending the separate stresses (based respectively on reduced and actual sections) are to be added.

In single-angle members the plane of buckling is to be considered parallel to the outstanding leg, but the moment of inertia of the member shall be reduced to 40 per cent for single-riveted connections and to 60 per cent in other cases to take account of eccentricity of loading.

Open-web compression members shall be computed in the same way as solid members, except that the buckling load shall be taken as $R_t = R_o R_o'/44{,}000$, where R_o is the ultimate strength of the column as a whole and R_o' the ultimate strength of the segment of member or rib between lattice connections; but if the ratio $R_o'/44{,}000$ exceeds 85 per cent the member may be proportioned as if a solid-web section. The strength of a rib segment R_o' is to be calculated for flexure in the direction of the least radius of gyration, and for a free length equal to the center-to-center spacing of connections between ribs.

Column shear is to be computed by the formula

$$0.03\ P\ (44{,}000/R_t - 1)$$

in which P is the axial load.

Column length l in the formulas is to be taken as the distance between panel points, except where buckling in the plane of the gusset plates is considered, when 0.8 of that distance is to be taken (except for angles with single-rivet connections).

Compression flanges of lattice girders are to be designed for a buckling length transverse to the girder

$$l = \pi \sqrt[4]{I\ a\ h^2/12\ I'}$$

in which I is the moment of inertia of the flange around its vertical axis, I' is the average moment of inertia of the verticals, a is the panel length and h is the depth of the girder. Plate girders without lateral bracing are to be designed in such a way that lateral buckling of the compression flange cannot occur.

Special Members

Trusses, purlins and jack rafters may be calculated as continuous girders or as cantilever girders when so built that they act accordingly. If lateral bending of purlins is not prevented by sag bracing or equivalent means, the stresses due to such bending shall be taken account of.

Members with eccentric tension are to be proportioned for a stress increased by 100 per cent, 40 per cent, or 25 per cent, if their end connections contain one, two or three rivets.

Deflections of sash members and girts shall not exceed 1 500th of the length.

Crane girders carrying power-operated cranes shall be designed for the braking thrust, which is to be calculated, but shall be taken as not less than 5 per cent of the load braked; this thrust is to be resisted by one girder. Crane girders may be calculated as continuous spans if detailed and supported correspondingly. When a column may receive load from three (or four) crane girders simultaneously the maximum reaction may be taken as 85 (or 70) per cent of that corresponding to simultaneous maximum loads. The columns shall be able to resist the lateral crane thrust.

Column bed-plates are to be designed for a maximum edge stress of 142 lb. per sq.in. for brick masonry, 255 for concrete, and 355 lb. for cut stone. The moment at the column foot taken account of in this calculation must correspond to that used in the design of the structure and in detailing the bed-plates, anchor bolts and footings. The maximum anchor-bolt stress shall be 14,200 lb. per sq.in. at root of thread.

Workmanship

The section of the specification covering workmanship provides for punched work exclusively. Perfect centering of rivet heads with body is not required, tests having shown this not to be a factor in rivet strength. Partial shop assembly is required when the fabricator does not erect. Material is to be wire-brushed before assembly, and is to be painted with red lead paint after assembly riveting. Faces assembled in contact are not painted.

For export work especially careful preparation of erection plans and erection marking is called for. Each box or bundle is to be marked with a strip of color indicating its contents. Boxes must not exceed 880 lb. in weight. Large pieces must be protected from injury in shipment. An excess of 10 per cent bolts and 20 per cent rivets is to be supplied.

When the weight of a piece is more than 6 per cent below the calculated weight the piece may be rejected. Payment is to be made according to actual weight up to an excess of 5 per cent over design weight. Pieces that cannot be weighed are to be billed at 3 per cent over the design weight.

Material and labor for seating columns on their foundations are to be furnished by the purchaser, according to the directions of the builder, except that sheet lead is to be furnished and placed by the builder.

Pavement on Curves Widened By Ring Method

By Edward H. Stelle
Assistant Engineer, Minnesota Highway Department

THE method of widening pavement on curves detailed in the accompanying diagram is new and has several advantages over most other methods now in general use throughout the country. The method of computing the area and setting the forms may be clearly understood from a study of the diagram.

If additional width on curves is, or will be, required within the life of the pavement then it would seem logical to say that this width should be uniform for the full length of the curve. Many departments have adopted a method requiring the use of a lune placed either on the inside or outside of the circular pavement. Such a scheme gives a maximum widening at the middle of the curve, diminishing both ways to zero some distance from the point of curve and point of tangency. Such a lune is wrong in principle for it either adds too great a width at the middle or not enough near the beginning and end of the curve.

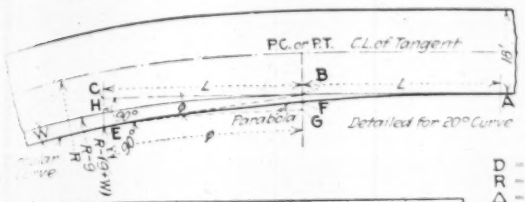
TABLE I. TABLE OF COMPUTATIONS

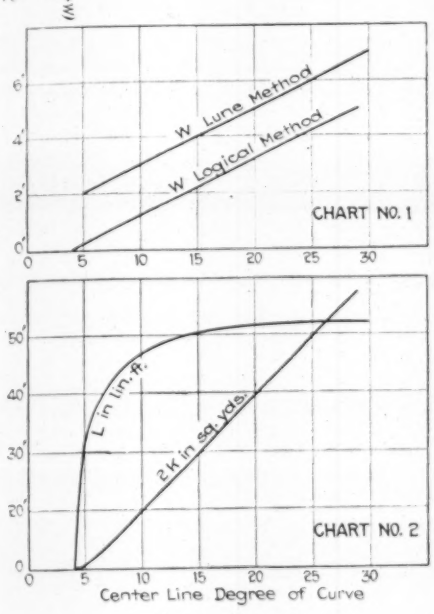
D	W, Ft.	R-9 Ft.	EB, Ft.	Θ	i, Ft.	K_1, Sq.Ft.	K_2, Sq.Ft.	K, Sq.Ft.
4½°	0.1	1264.240	15.901	0°43.9′	15.900	0.53	1.07	1.60
5°	0.2	1136.916	21.324	1°04.5′	21.320	1.42	2.84	4.26
5½°	0.3	1032.742	24.890	1°22.8′	24.883	2.49	4.97	7.46
6°	0.4	945.930	27.506	1°40.0′	27.494	3.67	7.33	11.00
6½°	0.5	872.474	29.533	1°56.4′	29.516	4.92	9.84	14.76
7°	0.6	809.512	31.162	2°12.3′	31.139	6.23	12.45	18.68
7½°	0.7	754.944	32.503	2°28.0′	32.473	7.58	15.16	22.74
8°	0.8	707.198	33.629	2°43.5′	33.590	8.96	17.93	26.89
8½°	0.9	665.069	34.588	2°58.8′	34.541	10.36	20.75	31.11
9°	1.0	627.620	35.415	3°14.0′	35.359	11.78	23.57	35.35
9½°	1.1	594.114	36.136	3°29.2′	36.069	13.23	26.49	39.72
10°	1.2	563.958	36.770	3°44.5′	36.692	14.68	29.43	44.11
10½°	1.3	536.675	37.332	3°59.3′	37.241	16.14	31.35	47.49
11°	1.4	511.871	37.832	4°14.3′	37.729	17.61	35.31	52.92
12°	1.6	468.465	38.685	4°44.2′	38.553	20.57	41.18	61.75
13°	1.8	431.737	39.383	5°14.0′	39.219	23.53	47.25	70.78
14°	2.0	400.256	39.963	5°43.8′	39.763	26.51	53.31	79.82
15°	2.2	372.972	40.450	6°13.6′	40.212	29.49	59.36	88.85
16°	2.4	349.099	40.864	6°43.3′	40.583	32.46	65.38	97.84
17°	2.6	328.034	41.219	7°13.0′	40.893	35.44	71.42	106.86
18°	2.8	309.310	41.524	7°43.0′	41.148	38.40	77.61	116.01
19°	3.0	292.557	41.789	8°12.8′	41.361	41.36	83.66	125.02
20°	3.2	277.479	42.020	8°42.6′	41.535	44.30	80.76	134.06
21°	3.4	263.837	42.220	9°12.5′	41.676	47.23	95.83	143.06
22°	3.6	251.436	42.395	9°42.4′	41.788	50.16	101.88	152.04
23°	3.8	240.112	42.549	10°12.4′	41.876	53.04	107.94	160.98
24°	4.0	229.733	42.683	10°42.4′	41.940	55.93	113.99	169.92
25°	4.2	220.183	42.801	11°12.6′	41.985	58.78	120.10	178.88
26°	4.4	211.369	42.903	11°42.7′	42.010	61.63	126.10	187.73
27°	4.6	203.207	42.992	12°12.8′	42.019	64.43	132.13	196.56
28°	4.8	195.628	43.069	12°43.0′	42.013	67.20	138.11	205.31
29°	5.0	188.572	43.136	13°13.4′	41.992	69.99	144.22	214.21
30°	5.2	181.986	43.192	13°43.8′	41.958	72.73	150.17	222.90

The ring method minimizes the disadvantages of most other methods, is simpler in theory and in practice, and results in a more economical distribution of the extra pavement. With a condensed set of tables the inside edge can be layed out efficiently with less experienced men, and the office work of obtaining the area is much less than with the ponderous formulas and computations involving a study of the probable errors, required to compute the area of a figure bounded by two circles having different centers and two short lengths of tangent. The results of computations for the ring method are readily adapted to tabulation on account of the fact that most of the functions are constant for each degree of center line curve regardless of the intersection angle. An explanation of the theory and practice governing the ring method follows:

Theory—(1) Values of W were aribtrarily assumed as sufficient to care for development of traffic conditions, and all computations depend on these assumed values.

(2) Widening Circle GEE'G' is concentric to center line





LEGEND

D = Degree of Center Line Curve
R = Radius " " " "
Δ = Intersection Angle of C.L. Curve
Φ = Angle of Transition = GBE
W = Additional Width of Pavement
L = Half Length of Transition
k_1 = Area of ABEFA
k_2 = " " BHEB
K = " " ABHEFA = $k_1 + k_2$
P = " " Circular Ring EHH'E'

Constant for each Degree of Curve regardless of Δ

FORMULAS

(1) $AB = BC = L$

(2) $EB = \sqrt{(R-9)^2-(R-9-W)^2} = \sqrt{2W(R-9)-W^2}$

(3) $\sin\phi = \frac{EB}{R-9}$

(4) $L = EB \cos. \phi$

(5) $CE = 2W$ (Closely Approx.)

(6) $k_1 = \frac{(2L \times W)}{2} \times \frac{1}{3} \quad \frac{WL}{3}$

(7) $k_2 = \frac{\frac{(R-9)^2}{2}\left[\frac{\pi}{180} 2\phi - \sin 2\phi\right]}{2}$

(8) $k_2 = \frac{EB}{2}\left[W+(R-9)(\text{vers.}\frac{\phi}{2}+\text{vers.}\frac{\phi}{4}+\text{vers.}\frac{\phi}{8}\text{ etc.})\right]$

(9) $K = k_1 + k_2$

(10) $K = WL$ (Approx. Max. Error $\frac{1}{4}$ Sq. Yd. for 29°C.)

(11) $P = W\left[\pi(R-9-\frac{W}{2}) \frac{\Delta-2\phi}{180}\right]$

(12) Total Additional Area for one complete Curve $P+2K$

(13) Offset from Tangent CA to Parabola AFE at any Point a Distance x from $A = \left(\frac{x}{2L}\right)^2 \times 2W$

the engineer needs for a particular Curve is: The degree of center line Curve and a copy of charts No. 1 and No. 2. A simple computation with formula No. 13 gives the offset to the parabola at any point. The concentric ring can be laid out from the center line stakes.

Office. To compute area of additional width for any given curve, figure area of ring by formula No. 11 and add the value of 2K from chart No. 2.

Remarks—Assuming that additional width is necessary on curves it follows that this width is necessary around the *whole* Curve. This condition is more nearly attained by the "Ring Method," than by the "Lune Method."

The uniform width allows the use of the finishing machine for the entire Curve.

With the use of one additional table no figuring whatever would be necessary.

All tables and charts are adaptable to the "Lefax" Hand Book.

Chart 1, Fig. 2, shows the amount of additional width which was used as the basis for all the computations given. These values were arbitrarily assumed as sufficient to care for the development of traffic conditions but are open for discussion, study and experiment.

Curve, with radius R-(9 + W), and is connected with tangent AB by a parabola. BE is the only line through B tangent to Circle GEE'G'.

(3) Since W is assumed for each degree of Curve the dimensions and area between the parabola and line HBA are constant for each degree of Curve. The area of the circular ring is the only variable and the one computation necessary (Formula No. 11).

(4) Sufficient decimal places have been used in computing table to keep the limit of probable error within 0.01 of a lineal or square foot, as the case might be. It should be borne in mind that six place logarithmic and natural tables are not sufficient in some of the computations.

Practice—(1) Field. To lay out forms for pavement all

TABLE II. OFFSETS TO PARABOLA

Deg of Curve	10′	20′	30′	40′	50′	60′	70′	80′	2 L	2 W	Corr. for 5′
4 5	0 02	0 08	0 18	....	....	....	....	....	31 80	0 20	0 00
5 0	0 02	0 09	0 20	0 35	....	....	....	....	42 64	0 40	0 01
5 5	0 03	0 10	0 23	0 40	....	....	....	....	48 77	0 60	0 01
6 0	0 03	0 11	0 24	0 42	0 66	....	....	....	54 99	0 80	0 01
6 5	0 03	0 12	0 26	0 46	0 72	....	....	....	59 03	1 00	0 01
7 0	0 03	0 12	0 28	0 49	0 77	1 11	....	....	62 28	1 20	0 01
7 5	0 03	0 13	0 30	0 53	0 83	1 19	....	....	64 95	1 40	0 01
8	0 04	0 14	0 32	0 57	0 89	1 28	....	....	67 18	1 60	0 01
8 5	0 04	0 15	0 34	0 61	0 94	1 36	....	....	69 08	1 80	0 01
9 0	0 04	0 16	0 36	0 64	1 00	1 44	1 98	....	70 71	2 00	0 01
9 5	0 04	0 17	0 38	0 68	1 06	1 52	2 07	....	72 14	2 20	0 01
10 0	0 04	0 18	0 40	0 71	1 12	1 61	2 18	....	73 38	2 40	0 01
10 5	0 05	0 19	0 42	0 75	1 17	1 69	2 30	....	74 48	2 60	0 01
11 0	0 05	0 20	0 44	0 79	1 23	1 77	2 41	....	75 46	2 80	0 01
12 0	0 05	0 22	0 48	0 86	1 34	1 94	2 64	....	77 11	3 20	0 01
13 0	0 06	0 23	0 53	0 94	1 46	2 11	2 86	....	78 44	3 60	0 02
14 0	0 06	0 25	0 57	1 01	1 58	2 28	3 10	....	79 53	4 00	0 02
15 0	0 07	0 27	0 61	1 09	1 70	2 45	3 34	4 35	80 42	4 40	0 02
16 0	0 07	0 29	0 66	1 17	1 82	2 62	3 57	4 66	81 17	4 80	0 02
17 0	0 08	0 31	0 70	1 24	1 94	2 80	3 81	4 98	81 79	5 20	0 02
18 0	0 08	0 33	0 75	1 32	2 07	2 98	4 06	5 30	82 30	5 60	0 02
19 0	0 09	0 35	0 79	1 41	2 20	3 17	4 30	5 61	82 72	6 00	0 02
20 0	0 09	0 37	0 84	1 49	2 32	3 34	4 55	5 94	83 07	6 40	0 02
21 0	0 10	0 39	0 87	1 54	2 41	3 47	4 72	6 15	83 35	6 80	0 03
22 0	0 10	0 41	0 93	1 65	2 58	3 71	5 05	6 60	83 58	7 20	0 03
23 0	0 11	0 43	0 97	1 73	2 71	3 90	5 30	6 92	83 75	7 60	0 03
24 0	0 11	0 46	1 02	1 82	2 85	4 10	5 59	7 29	83 88	8 00	0 03
25 0	0 12	0 48	1 07	1 91	2 97	4 28	5 82	7 61	83 97	8 40	0 03
26 0	0 12	0 50	1 12	2 00	3 13	4 50	6 12	8 00	84 02	8 80	0 03
27 0	0 13	0 52	1 18	2 08	3 26	4 70	6 40	8 34	84 04	9 20	0 03
28 0	0 14	0 54	1 22	2 18	3 40	4 80	6 69	8 70	84 03	9 60	0 03
29 0	0 14	0 57	1 28	2 27	3 54	5 10	6 93	9 05	83 98	10 00	0 04

Table II eliminates the necessity of any calculations in the field except for interpolation for offsets to the parabola for odd feet of distance from the point *A*. The author has computed a table of areas in square yards for rings (for each degree of center line curve) of one degree central angle and of one minute of central angle. With such a table the only computation necessary is that of multiplying the tabular value for the area of one degree of angle by the number of whole degrees in Δ — 2 Φ, multiplying the tabular value for one minute of angle by the number of minutes left in Δ — 2 Φ, adding the sum of these results to 2*K* (chart No. 2), and the result is the total additional area of pavement

Hand and Machine Tamping

Finishing and tamping machines are rapidly becoming a standard requirement for pavement construction of any magnitude. The manufacturers making these machines with adjustable tread, that is, the machines can be used on different widths of pavement by a simple adjustment. A curve widened by any means other than a concentric circle will have a variable width throughout the length of the curve and must be hand tamped and finished. The ring method obviates this difficulty largely since the greater part of the curve is of uniform width.

The parabola is of sufficient length to take care of the transition from a crowned section to a superelevated flat slab, and while shorter, serves as an adequate substitute for the transition or spiral curve required in railroad practice.

The above described method together with formulae and computations is offered for consideration, discussion and criticism.

Smoke Abatement Study and Plans at Salt Lake City

Proposed Ordinance Includes Residences—Expert Supervision—Nuisance Is Great with Small Coal Consumption

ALTHOUGH Salt Lake City, Utah, is not a great industrial point or a large railway center, and although its coal consumption and smoke production are low as compared with many cities, it is troubled with a very serious smoke nuisance due to a combination of local conditions. With a view to effecting a remedy, the city, in February, 1919, authorized an investigation by Sylvester Q. Cannon, city engineer, and this investigation was carried out for the period from Sept. 1, 1919, to May 1, 1920, under an agreement between the city, the University of Utah and the U. S. Bureau of Mines. The following information on the subject is compiled from a comprehensive report to the Director of the Bureau of Mines by Osborn Monnett, consulting engineer, Chicago.

The city's sheltered position in a valley bounded by mountains on three sides has a marked influence upon wind velocity. This velocity is lowest during the winter and the most unfavorable combination of meteorological conditions prevails during the months when heating plants are in use. Further, the temperature and wind are low in the early morning, which is the time of maximum smoke production. Smoke-abatement work in other cities is based generally upon day observations, as the wind is sufficient to disperse smoke produced during the night, but at Salt Lake City it is necessary to take into account the smoke production of both day and night.

Fuel Survey—Interest centers mainly in the survey methods and the proposed remedies, since the local conditions are not those generally encountered. In the first place a fuel survey was made to determine the amount and kind of coal used, and the amounts used for different purposes. The total consumption for the summer and winter of 1918-1919 was about 513,200 tons. A house-to-house inquiry conducted by Boy Scouts served to show the amount used by residences, the amounts for other classes of consumers being obtained by questions sent to the consumers. From the smoke standpoint the pronounced characteristic of Utah coal is its high percentage of volatile matter, as in general the smoke production increases with this percentage. Experiments made as a part of the investigation, however, showed that the methods of handling coals of high volatile content in cities of the Middle West are adequate for smokeless combustion of the Utah coal.

Smoke Chart Observations—Observations on the Ringelmann chart system, covering the various classes of smoke producers, were begun in September, 1919. The readings were taken for one-hour periods through out the day, so that in combination with the records of consumption by these different classes it was possible to figure the percentage of smoke made by each class for any desired period. Smoke producers were divided into five classes for the purpose of the report: (1) Industrial and large heating plants; (2) small heating plants; (3) locomotives; (4) residences; (5) miscellaneous. The first class included creameries, hospitals, industrial furnaces and boiler plants, laundries, office buildings and central heating plants. The second class included apartment houses, business places, churches, hotels, schools and public buildings. The percentages of city smoke for these classes were tabulated for the year, the six winter months, the six summer months and for each month. Classes 1 and 3 make a larger proportion of the total during the summer. Classes 2 and 4 make a larger proportion during the winter. The approximate percentage of coal used and total smoke produced for the six winter months, the six summer months and the 12 months from April 1, 1919, to March 31, 1920, are given in Table I.

TABLE I. CLASSIFICATION OF SMOKE AT SALT LAKE CITY, 1919–1920

Class	Oct.-Mar., 1919–1920 Per Cent of Coal Consumption	Oct.-Mar., 1919–1920 Per Cent of Total Smoke	Per Cent of Total Smoke Apr.-Sept., 1919	Per Cent of Total Smoke April, 1919, to March, 1920
1. Large plants	27	39 64	52 64	44 58
2. Small plants	11	12 08	4 80	9 04
3. Locomotives	7	13 18	27 11	18 38
4. Residences	48	27 35	12 04	21 83
5. Miscellaneous	7	7 75	3 41	6 17
Total	100	100 00	100 00	100 00

High smoke densities were shown by the average heating and industrial plants, due to three causes: (1) Lack of engineering supervision of the original installation; (2) high volatile content of the coal; (3) lack of supervision of operation by the city. In some cases the densities were 45 to 65 per cent, although, as Mr. Monnett explains, in cities where close smoke supervision has been in force for several years similar plants must run with a density of 2 per cent to be considered satisfactory. According to his report there is nothing in the service or conditions at Salt Lake City which make it impossible or difficult to obtain smokeless results. The quality of the coal is beyond control, but it is superior to that available in most of the Western States and the report remarks that the city is fortunate in having coal of this quality. Supervision of the installation and operation of plants are readily put under the control of the city government.

Atmospheric Pollution—Study of the pollution of the city's atmosphere by soot and other impurities was necessary, since the nuisance is so great in proportion to the coal consumption, owing to the low wind velocity in an enclosed valley. A city of equal size and equal consumption, but situated in a region of higher wind velocity, might show identical records on the Ringelmann charts and yet have very little smoke nuisance.

TABLE II. SOOT FALL IN WINTER MONTHS
(Tons per square mile per annum)

City	Soot Fall Min.	Soot Fall Max.	Soot Fall Mean	Coal Consumption Tons
Salt Lake City	15	980	250	510,000
Glasgow	....	....	1,325	3,250,000
London	58	426	260	16,000,000
Leeds	25	539	220	1,500,000
Hamburg	345	690	.....	2,000,000
Pittsburgh	595	1,807	.....	.....

Atmospheric pollution includes soot and ash from fuel combustion, gases from fuel combustion, and dust from non-fuel origin. The winter figures of soot fall are those of most importance in comparison with other cities where the smoke nuisance is not confined to one season and such figures for a number of cities are given in Table II. The report points out that in comparison with its coal consumption Salt Lake City ranks highest

on the list, even taking into account its smaller area.

When the smoke nuisance of Salt Lake City is at its height in winter the atmosphere is remarkably free from dust of non-fuel origin but contains relatively large amounts of soot and ash from coal fires owing to its color and finely divided state. Such material is a much greater nuisance, says Mr. Monnett, than the coarser and heavier dust. Thus, although the weight of solid matter in the atmosphere is not extremely high, the nuisance is great when considered in terms of soiling and damaging fabrics and architecture. Carbon dioxide and sulphur dioxide are negligible factors.

Supervision of new installations of coal-burning equipment is particularly necessary at Salt Lake City in view of the weather conditions. This applies especially to residences, even those of the smallest size. Mr. Monnett states that no city in this country includes residences in the provisions of its smoke ordinances, most of the ordinances exempting all heating plants smaller than those for six-apartment buildings. In his opinion no new residence building at Salt Lake City should be erected without having its plans for heating equipment examined by the smoke inspector as to the capacity of the furnace or boiler in respect to its load, the height and area of chimney, the flues, fireplaces, hot water heaters and other features.

Smoke-Abatement Ordinance—On the basis of the investigation, an ordinance for smoke inspection and abatement has been drafted to meet the existing conditions. In addition to including all residence buildings it gives a code of minimum head room and other conditions under which boilers may be set. It is stated that such a code has operated successfully elsewhere, although few cities include it in their ordinances. Mr. Monnett points out that one advantage of such a code in the ordinance is that it forestalls charges of favoritism against the inspector and insures that good installations will be provided in the future, as it eliminates the personal ideas of those enforcing the ordinance and thus prevents lowering of the standards.

Under the proposed ordinance a chief smoke inspector would be appointed by the mayor, with the consent of the city commission, at a salary of $3,000 per year. The inspector would appoint two deputies and two assistants at $2,400 and $1,800 respectively. No power or heating plant, chimney, etc., may be erected, altered or rebuilt until a permit has been issued by the smoke inspector after examination of plans and specifications which are to be filed with him and which must cover points of information specified in the ordinance. When the permit is issued, the inspector will notify the commissioner of buildings, who will see that the work is carried out according to the plans and specifications. Finally, the plant must not be operated until the smoke inspector has certified that it complies with the plans and specifications. Requirements as to boiler settings, flues, furnaces and stokers are given in considerable detail. A fee of $1 for filing plans and receiving permit is provided by the ordinance, but this may be remitted for institutions which are not operated for profit.

Smoke is to be considered "dense" when it is equal to No. 3 on the Ringelmann smoke chart as published and used by the U. S. Geological Survey. Emission of dense smoke for more than one minute from a locomotive, steam roller, derrick or pile driver is declared a nuisance, except for a period not exceeding six minutes in any one hour when the firebox is being cleaned or a new fire built. Emission of dense smoke from any chimney or smokestack, from the stack of a tar kettle or similar contrivance, or from any open bonfire, tank, vat or other receptacle is declared a nuisance, except for six-minute periods as noted above. Any such nuisance may be abated summarily by the smoke inspector, who will also prosecute for all violations of the ordinance. The fine on conviction of nuisance is from $10 to $100 for each offense, each day of such emission of dense smoke to constitute a separate offense. Permits from the inspector do not exempt their holders from prosecution for smoke nuisance.

It is provided that the chief smoke inspector shall be "an engineer qualified by training and experience in the theory and practice of the construction and operation of steam boilers and furnaces and also in the theory and practice of smoke abatement and prevention." The deputy inspectors must have the same qualifications as to boilers and furnaces and Mr. Monnett suggests that they should be chosen after an examination equivalent to that required in obtaining a license as an operating steam engineer. The assistant inspectors are not required to have an engineering training.

Control of the Smoke Nuisance—It is recommended that smoke abatement should continue under a systematic plan throughout the year, although the smoke nuisance is at its worst for only a short time. There is a large amount of necessary reconstruction work which can be done only during the summer, and at this time the installation of smoke indicators should be urged, so that the firemen may know when they are making smoke. This is important, as a great deal of smoke is made before daylight. In summer, also, negotiations may be opened with the railways for equipping switch engines and other locomotives with quick-opening blower valves, induction tubes, multiple-tip blowers and brick arches. Educational work must be taken up with the householders, to teach them the importance of clean chimneys and proper methods of firing.

Smoke observations should be made by at least one man during daylight hours in the spring, summer and early fall, in order that the department may keep informed as to plants which are making smoke and are liable to cause trouble later. As the heating season approaches, a policing or follow-up system should be planned in regard to the early morning firing, with regular visits to plants which make or are likely to make smoke at this time. As the season progresses, it may be necessary to put more men on this work, especially for the first few seasons.

As to the future policy of the smoke department, Mr. Monnett points out that the department should avail itself of improvements that may be developed in matters of burning coal. Thus, there is a possibility of the successful application of pulverized coal at some plants. For residences, it should be the policy to secure for new buildings the use of the best type of equipment available. In many cases the saving in attention required will soon cover the cost of installation and the fuel can be burned more economically and without smoke. In Mr. Monnett's opinion, the downtown district of Salt Lake City is an ideal situation for a central steam heating system and this would eliminate many of the worst smoke producers.

Wanted: Formulas For Design of Air-Inlet Valves

Neglected Feature of Pipe-Line Design Is Field for Experimental Investigation or Possibly College Thesis

By H. L. Thackwell
Hydraulic Engineer, Anaconda, Mont.

SO FAR as the writer has been able to discover there are no suitable formulas for the design of air inlet-valves for pipe lines. The only formula which we have seen is an empirical one given in the American Civil Engineers Pocket-Book, "One square inch in area for each diameter foot of the pipe," also $\frac{1}{24}$ of the area of the pipe. This is obviously a mere rule of thumb, which if strictly followed, would lead to dangerous or extravagant design.

The controlling factor is not only the diameter of pipe, but with it the displacement in cubic feet per second, which causes a vacuum at the points along the pipe line which are intersected by a falling grade line. It can readily be seen that if a pipe line is entirely beneath the hydraulic grade line when the pipe is flowing 100 sec. ft., that when the flow drops to 50 sec. ft. the grade line will also fall and may, according to the profile, intersect a number of points along the line. At these points the pipe would not be full, and consequently a vacuum would be established unless suitable air-valves were placed at the points to equalize the air pressure on the inside and outside of the pipe.

The writer has derived the following simple formula for determining the required area of air inlet valves to equalize the air pressure under the above conditions.

$$A = \frac{Q}{1.35}$$

Where A = Area of circular orifice of air-valve in sq.in.

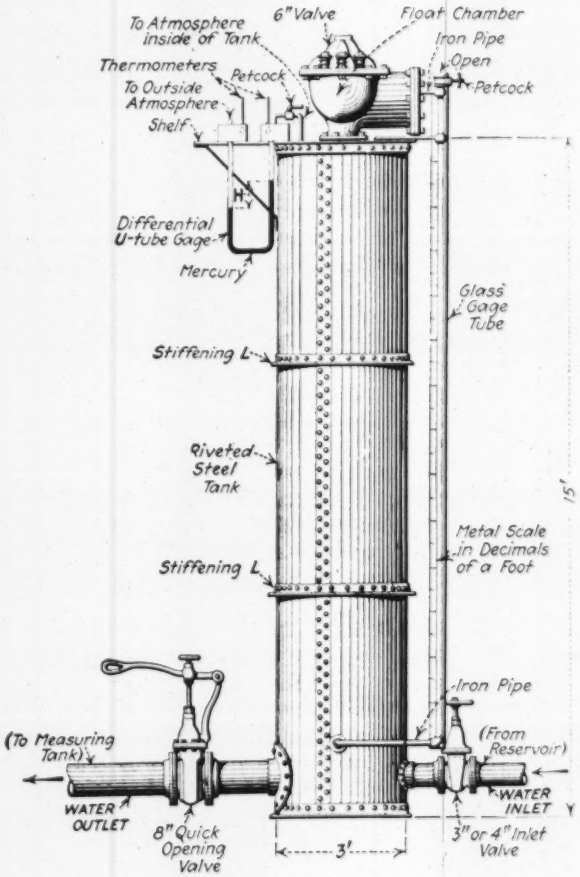
Q = Flow of water in sec. ft. at the time in hydraulic grade line intersects the pipe line.

This formula is not based upon experiment, but is approximate, having been derived from general laws on thermo-dynamics, with the assumption of a constant temperature of 62 deg. F. and isothermic compression. Obviously it does not take into consideration the resisting strength of a pipe against external pressure.

The writer suggests that this topic could be made the subject of a thesis, and that a reliable formula be derived by experiment.

In the accompanying drawing is a suggestion for the form of apparatus necessary to obtain the experimental data. The apparatus is essentially a steel tank 15 ft. long and 3 ft. in diameter, having stiffening angles occasionally to keep the tank from crushing under an external atmospheric pressure. At the bottom of the tank are two valves. One of these is an inlet water valve, while the other is a quick-opening outlet valve. At the top of the tank is mounted a Rensselaer No. 40 6 in. automatic cluster air-valve, combined with lever and float attachment for air-pocket" control. A mercury U-tube differential gage with thermometer attachments should be mounted at the top of the tank. At the bottom of the tank, at a point well away from the outlet valve, should be inserted a glass gage tube which would extend to a point equal in height to the top of the dome in the air-valve chamber. This gage should be connected to the valve-chamber by a small iron tube. Just above this connection should be placed a pet-cock; the short section of the tube extending above the pet-cock should be left open to the atmosphere. A metal scale should extend the full height of the gage tube. The rest of the equipment consists of a measuring tank and stop-watches.

The steps necessary to work the apparatus are as follows: First: Open the pet-cock at the top of the glass gage-tube, and close the pet cock between the tank and the U tube. Second: Close the quick-opening outlet-valve and open the inlet water valve. Allow the water to run into the tank until a spill is observed at the top of the glass gage-tube. Shut the water off at the inlet valve, and after the gage-tube ceases to spill, shut the pet-cock at the top of the gage-tube and open



SUGGESTED DETAILS OF APPARATUS FOR TESTING AIR INLET VALVES

the valve between the tank and the U-tube. Third: Read the U-tube gage and the temperatures, then quickly open the outlet valve and observe the volume of water in the measuring tank at each second of elapsed time. At these same time intervals the glass gage-scale should be read. Also the U-tube and temperature readings should be noted.

These data should be first taken with a cluster of six valves free to work, then with one valve blocked up so it will not operate under the atmospheric pressure, then with two valves blocked up and so on, until only one valve is in active operation. These data with the various calibrated sizes of air-valves could then be plotted up

as curves, and suitable formula derived to fit the curves in question.

Finally several sections of lap-riveted and wood-stave pipe should be tested to failure from external atmospheric pressure, caused by decreasing the internal pressure by a vacuum pump. Care must be taken in selecting the pipe of such length so that the end bulkheads will not materially strengthen the pipe against external pressure. The difference in pressure at the time of failure should be plotted against the diameters of pipes and suitable formulas derived to fit the curves.

The importance of this subject is not properly appreciated except by those engineers who have been engaged in the design of extensive wood-stave and steel pipe lines under a low head and variable flow conditions. Hydraulic engineers in general would be grateful to any one who would present a suitable exponential formula, which is based on a carefully conducted series of experiments.

Sacramento Adopts Cost-Plus Plan On Water Filter Work

By C. G. Gillespie
Resident Engineer, Filtration Division, Sacramento, Cal.

Construction is about to start on the water-supply portion of the Sacramento filtration plant following approval of legality, by the Superior Court, on a cost-plus-a-fixed-fee contract with a bonus and penalty clause and provision for an advance payment of 20 per cent of the fee. This portion of the project is expected to cost $1,035,200 and will be accomplished for about $600,000 less than the lowest lump-sum bid. It includes sluice gate, centrifugal pumps, steel force main and intake works, pumping station, motors, transformers, switchboards, traveling crane, etc. Before this form of contract was adopted endeavors were made to let the work on a lump-sum basis. The city's experience in this attempt is set forth in the following notes with the idea that it may be useful elsewhere when similar situations arise.

Lump-sum bids were first received on Oct. 14 on a basis whereby the bid could be made separately on each of several subdivisions of the general contract or on the work as a whole. The bidders were required to purchase to the amount of the bid submitted plus 15 per cent and at not less than par, bonds of average maturity yielding 4½ per cent. This requirement undoubtedly discouraged bidding, for in spite of a great deal of publicity through local and national engineering journals, by correspondence and by postponement of bids to allow seven weeks for bidding, only ten bids which could be considered were received. These included only two bids on the general contract and none whatever on three of the items offered for separate bidding. The general-contract bids so far exceeded the engineers' estimates that all were rejected and the city sought a cost-plus-fee contractor.

The invitation for cost-plus propositions prescribed that they should contain an estimate of cost representing the contractor's best judgment of what the cost of the whole work would actually be, and also a penalty and bonus provision. On this basis six contractors submitted propositions and one of these, the Coast Construction Co. of San Francisco, was selected on the recommendation of the filtration division engineers. An agreement was drawn up between this contractor and the city in which the principal features are as follows:

1. The contractor, as agent for the city, agrees to organize and supervise the work and secure its accomplishment in a prompt, efficient, economical manner.
2. The contractor submits a detailed estimate of actual cost amounting to $807,294.
3. If the actual cost, after adjustment due to changes in freight rates, wage scales or changes in the amount or kind of work, exceeds this amount, there shall be deducted from the fee due the contractor, one-half the difference between the actual cost and the adjusted estimated cost, but the deduction shall not exceed $41,055.
4. If the final cost of the work is less than the adjusted estimated cost there shall be added to the contractor's fee a bonus amounting to one-half the difference between the final cost and the adjusted estimated cost, but the bonus shall not exceed $41,055.
5. In the event of changes in the amount or kind of work at the request of the city the fee for personal service will be increased or diminished by an amount equal to 10 per cent of the amount represented by the change based on prices as agreed or on prices in the estimate.
6. The total fee amounts are to be paid in installments distributed over the construction period.
7. The resident engineer may withhold the payments on the fee for an amount equaling the accrued penalty at any date of payment of fee.
8. If the amount paid the contractor for equipment which he agrees to furnish exceeds $39,411 (approximately 7 per cent of the actual cost) all overplus shall be deducted from the fee.
9. The agreement contains a definition of just what the estimate includes and the contractor agrees to perform the work strictly according to the specifications on which lump-sum bids were submitted, these specifications being made a part of the contract. Expenses over which the contractor has no control, however, are deducted from the cost before calculating the penalty or bonus to be paid.
10. The contractor takes all other responsibility for the safe and economical handling of the work, performing it, however, to the satisfaction and subject to the approval of the city. No purchases or employment can be made without the approval of the city.
11. The contractor has the right to select his employees and to discharge them as he sees fit, but he must discharge any one whom the city designates as unsatisfactory.
12. No penalty or bonus is calculated on extra work.
13. The contractor is to keep an accurate record of the cost of the work as it progresses, showing the allocation or apportionment of all invoices or payrolls for the respective items of the work in detail as directed by the resident engineer.
14. Although not a part of the contract it is expected that purchases will be made by the contractor, subject to the approval of the city rather than by the city direct; the city to advance warrants on the basis of approved invoices and the contractor to submit receipts therefor.
15. Provision is made for termination of the contract by the contractor for certain specified reasons, as follows: (a) If the work be stopped by an order of any court or competent public authority for a period of three months through no act or fault of the contractor; (b) if the monthly certificates of payment and the payments are not made according to the contract.
16. The city has the right to terminate the contract on breach of contract by the contractor or at any time it is not satisfied with the manner in which he is conducting the work.

Pittsburgh Enlarged by Annexation

Following a recent favorable popular vote for annexation to Pittsburgh, Pa., Chartiers Township, with a population estimated as 12,000, became a part of Pittsburgh on Jan. 1. It is expected that other outlying communities will follow suit.

Reduction Table for the Stadia Arc

By Walter S. Dix
Hydraulic Engineer, with Thomas E. Murray, Inc., New York City

THE Beaman stadia arc, attached to the engineer's transit, accords the quickest means of obtaining elevations in both field and office. Only those vertical angles are used for which the differences in elevation are simple multiples of the rod interval. The outer graduated arc of the attachment is marked "Vertical" and the graduations, which read from 5 to 95, differ by unity.

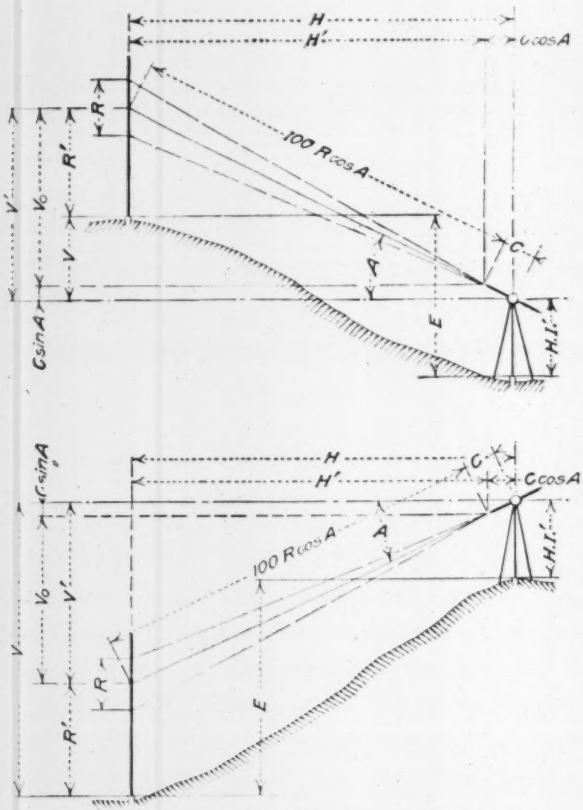


FIG. 1. USE OF THE STADIA ARC

Any number set opposite the index, after subtracting 50, equals the function $100 \times \frac{1}{2} \sin 2A$ of the angle A, at which the telescope is inclined. If, therefore, the "Vertical" arc reading is denoted by Av, and the rod intercept by R, then, in Fig. 1, the vertical distance

$$V_o = R\ (A_v - 50) \qquad (1)$$

This is plus or minus according to whether the telescope is sighted up or down, and is equal to zero when the telescope is level.

Also, the difference in elevations at the center of instrument and the point sought is, where R' is the height of rod,

$$V = V_o + C \sin A - R' \qquad (2)$$

The correction for stadia constant C sin A is plus or minus, corresponding to the sighting of the telescope up or down.

The reduction of the horizontal distance however, is not satisfactorily accomplished by means of the inner graduated arc marked "Horizontal," either in the field or in the office. Reading it in the field is difficult and consumes valuable time, due to the fact that there is a considerable radial space between it and the end of the index. Furthermore the graduations are the function $100\ (1 - \cos^2 A) = 100 \sin^2 A$, which gives the ratio of horizontal correction to the distance read as a percentage. It is difficult to make a correct interpolation between the graduations for a point opposite the index, corresponding to the setting for the "Vertical" arc.

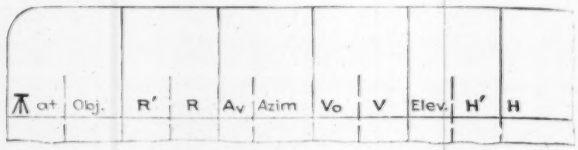


FIG. 2. FIELD BOOK RULING FOR USE WITH STADIA ARC

The accompanying table affords a more accurate and, with the aid of the slide-rule, a quicker method for determining the horizontal distance, H', in the diagram, which equals the function 100 $\cos^2 A$. The horizontal distance between the center of instrument and the point sought is

$$H = 100\ R \cos^2 A + C \cos A \qquad (3)$$

Ignore the "Horizontal" arc and read only the "Vertical" arc number, entering it in the field-book in the column marked A_v. Opposite this number in the table is the corresponding value of $\cos^2 A$, which multiplied by 100 times the rod intercept will give the distance direct.

REDUCTION TABLE FOR FACILITATING USE OF BEAMAN STADIA ARC

"Vert" Arc No.		Angle A	$\cos^2 A$	C sin A For C = 0.80	1.00	1.25	C cos A For C = 0.80	1.00	1.25
95	5	32-04.7	0.718	0.42	0.53	0.66	0.7	0.8	1.1
94	6	30-49.3	0.734	0.41	0.51	0.64	....	0.9	....
93	7	29-39.5	0.755	0.40	0.50	0.62	....	....	....
92	8	28-34.2	0.771	0.38	0.48	0.60	....	....	....
91	9	27-32.5	0.786	0.37	0.46	0.58	....	....	....
90	10	26-33.9	0.800	0.36	0.45	0.56	....	....	....
89	11	25-37.8	0.813	0.35	0.43	0.54	....	....	....
88	12	24-43.9	0.825	0.33	0.42	0.52	....	....	....
87	13	23-52.0	0.836	0.32	0.40	0.51	....	....	....
86	14	23-01.6	0.847	0.31	0.39	0.49	....	....	....
85	15	22-12.8	0.857	0.30	0.38	0.47	....	....	1.2
84	16	21-25.3	0.867	0.29	0.36	0.46	....	....	....
83	17	20-39.0	0.876	0.28	0.35	0.44	....	....	....
82	18	19-53.7	0.884	0.27	0.34	0.43	....	....	....
81	19	19-09.5	0.892	0.26	0.33	0.41	0.8	....	....
80	20	18-26.1	0.900	0.25	0.32	0.40	....	....	....
79	21	17-43.5	0.907	0.24	0.30	0.38	....	1.0	....
78	22	17-01.6	0.914	0.23	0.29	0.37	....	....	....
77	23	16-20.5	0.921	0.22	0.28	0.35	....	....	....
76	24	15-39.9	0.927	0.22	0.27	0.34	....	....	....
75	25	15-00.0	0.933	0.21	0.26	0.32	....	....	....
74	26	14-20.5	0.939	0.20	0.25	0.31	....	....	....
73	27	13-41.6	0.944	0.19	0.24	0.30	....	....	....
72	28	13-03.1	0.949	0.18	0.23	0.28	....	....	....
71	29	12-25.0	0.954	0.17	0.22	0.27	....	....	....
70	30	11-47.3	0.958	0.16	0.20	0.25	....	....	....
69	31	11-10.0	0.963	0.16	0.19	0.24	....	....	....
68	32	10-33.0	0.967	0.15	0.18	0.23	....	....	....
67	33	9-56.3	0.970	0.14	0.17	0.22	....	....	....
66	34	9-19.9	0.974	0.13	0.16	0.20	....	....	....
65	35	8-43.7	0.977	0.12	0.15	0.19	....	....	....
64	36	8-07.8	0.980	0.11	0.14	0.18	....	....	....
63	37	7-32.1	0.983	0.10	0.13	0.16	....	....	....
62	38	6-56.6	0.985	0.10	0.12	0.15	....	....	....
61	39	6-21.2	0.988	0.09	0.11	0.14	....	....	....
60	40	5-46.1	0.990	0.08	0.10	0.13	....	....	....
59	41	5-11.1	0.992	0.07	0.09	0.11	....	....	....
58	42	4-36.2	0.993	0.06	0.08	0.10	....	....	....
57	43	4-01.4	0.995	0.06	0.07	0.09	....	....	....
56	44	3-26.7	0.996	0.05	0.06	0.08	....	....	....
55	45	2-52.1	0.997	0.04	0.05	0.06	....	....	....
54	46	2-17.6	0.998	0.03	0.04	0.05	....	....	....
53	47	1-43.2	0.999	0.02	0.03	0.04	....	....	....
52	48	1-08.7	1.000	0.02	0.02	0.03	....	....	....
51	49	0-34.4	1.000	0.01	0.01	0.01	....	....	....
	50	0-00.0	1.000	0.00	0.00	0.00	....	....	....

Corrections C sin A and C cos A, for use with equations (2) and (3) respectively are also given in the table, the former to two places in order to facilitate quick determination of the value in accurate work permissible with short shots if desired. These corrections may be entered interlineally in columns V_o and H' respectively in the field-book.

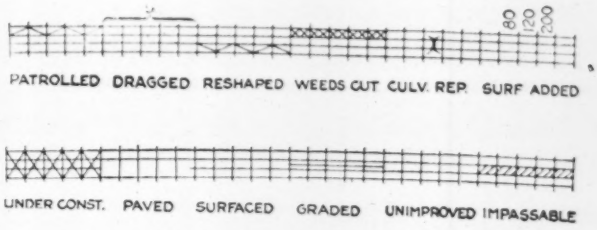
The rod intercept, R, and the rod height, R', are

found in the usual manner employed with the Beaman stadia arc. The field entries are made in the first six columns of ruling adapted to the lefthand page of the standard field-book, Fig. 2. The remaining columns are for office calculations. Experience has proved this suggested form of field-book satisfactory, and the table has proved a great time saver.

Maintenance Estimate and Progress Report Forms

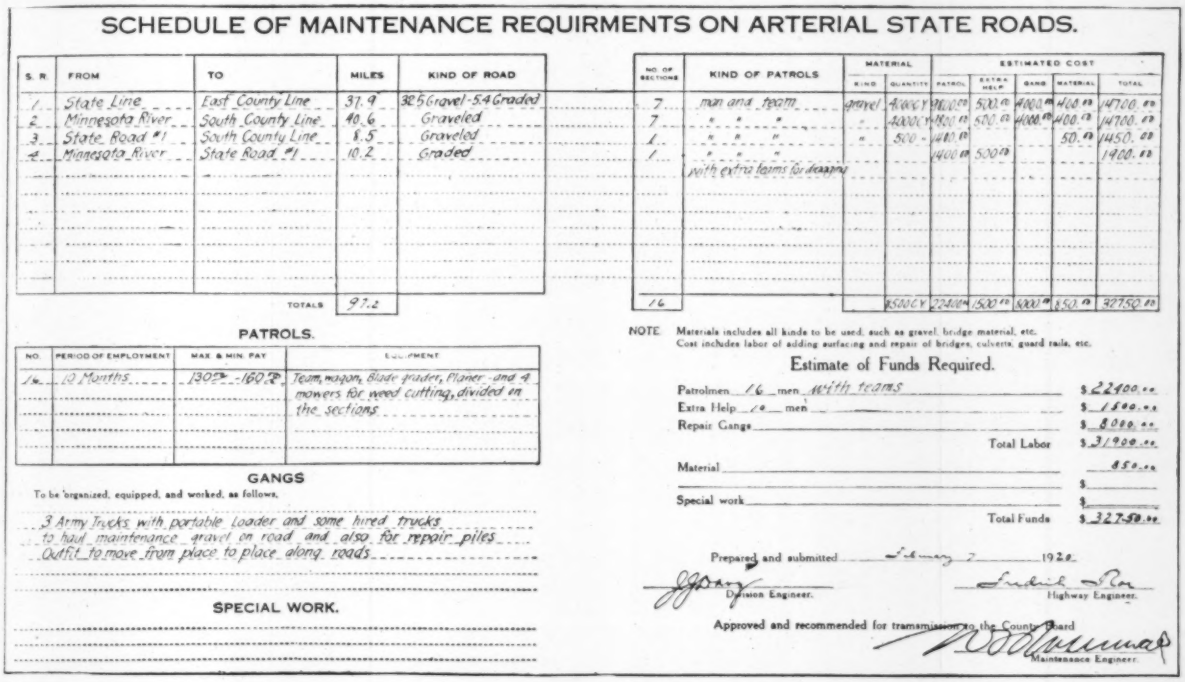
Estimates for State-Aid Highway Maintenance in Minnesota Prepared Ahead of Season for Each County

STATE-AID highway maintenance in Minnesota is apportioned on formal estimates and paid monthly on verified reports of work performed. In Minnesota the counties perform the maintenance work, employing the patrol system, which in 1919 was extended to all counties. In the 86 counties there are 12,362 mi. of state highway of which about 7,000 mi. are classed as trunk-line roads on which is put approximately 80 per cent of the total expenditure for maintenance. This expenditure for 1919 was $1,582,834, of which



2. SYMBOLS FOR MONTHLY GRAPH RECORDS OF MAINTENANCE WORK

The form, two pages of which are illustrated, is a four-page document. On the first page is printed the order which is signed by the commissioner of highways and the chief engineer, and on the last page is printed the resolution of adoption signed and sealed by the county auditor. The form, therefore, is a document of original record with the force, virtually, of a contract between the state highway department and the county board. When the estimates of all counties are completed, the state highway department possesses, well in advance of the season's maintenance work, a complete mileage and cost summary of state-aid maintenance for the year.



SCHEDULE OF MAINTENANCE REQUIRMENTS ON ARTERIAL STATE ROADS.

S. R.	FROM	TO	MILES	KIND OF ROAD
1	State Line	East County Line	37.9	32.5 Gravel - 5.4 Graded
2	Minnesota River	South County Line	40.6	Graveled
3	State Road #1	South County Line	1.5	Graveled
4	Minnesota River	State Road #1	10.2	Graded
		TOTALS	97.2	

NO. OF SECTIONS	KIND OF PATROLS	MATERIAL KIND	MATERIAL QUANTITY	ESTIMATED COST PATROL	EXTRA HELP	GANG	MATERIAL	TOTAL
7	man and team	gravel	4000 C.Y.	3100.00	500.00	4000.00	400.00	4700.00
7	" " "	"	4000 C.Y.	3100.00	500.00	4000.00	400.00	4700.00
1	" " "	"	500 - C.Y.	400.00			50.00	450.00
1	" " " with extra teams for dragging			1400.00	500.00			1900.00
16			8500 C.Y.	22400.00	1500.00	8000.00	850.00	32750.00

NOTE. Materials includes all kinds to be used, such as gravel, bridge material, etc. Cost includes labor of adding surfacing and repair of bridges, culverts, guard rails, etc.

PATROLS.

NO.	PERIOD OF EMPLOYMENT	MAX. & MIN. PAY	EQUIPMENT
16	10 Months	130.00 - 160.00	Team, wagon, Blade grader, Planer and 4 mowers for weed cutting, divided on the sections

GANGS

To be organized, equipped, and worked, as follows.

3 Army Trucks with portable Loader and some hired trucks to haul maintenance gravel on road and also for repair piles. Outfit to move from place to place along roads.

SPECIAL WORK.

Estimate of Funds Required.

Patrolmen 16 men with teams		$ 22400.00
Extra Help 10 men		$ 1500.00
Repair Gangs		$ 8000.00
	Total Labor	$ 31900.00
Material		850.00
		$
Special work		$
	Total Funds	$ 32750.00

Prepared and submitted February 7 1920

Division Engineer. Highway Engineer.

Approved and recommended for transmission to the County Board

Maintenance Engineer.

1. ESTIMATE FORM FOR STATE AID HIGHWAY MAINTENANCE IN MINNESOTA

$676,609 was state aid. The expenditure for 1920 will be materially greater.

In preparing for the season's maintenance, an estimate is made for each county of the work which is to be aided by the state. The highway engineer for the state highway department and the engineer for the county board prepare the estimate by agreement and enter it on the form shown by the illustration. When approved by the division engineer and by the maintenance engineer, the estimate is transmitted as an order to the county board which is required to pass a formal resolution of adoption.

Aid is paid on monthly records of work performed using a standard form. This form is a brown line print 36 x 9 in. folded to document size of 4 x 9 in. On two folds are certificates that the work recorded has been properly carried out, attested by the highway engineer and the division engineer; a certificate of claim for 50 per cent state aid by the county auditor; a statement of balance, and, finally, an approval for payment of state aid signed by the highway commissioner. On three succeeding folds is a tabulation of the work done on each road and of its cost. The remainder of the sheet shows a graph for each road indicating the work

done according to the symbols illustrated by the accompanying sketch. A brownprint for each month goes to each highway engineer, one for every county. When filled out and signed the print is returned to the state highway department, where it is audited and approved for state-aid payment. After this has been done a blueprint is returned to the highway engineer and another to the county auditor for their files of records.

These forms for estimates and monthly records provide a compact account of current maintenance work. W. F. Rosenwald is maintenance engineer and John. H. Mullen is chief engineer of the Minnesota Highway Department.

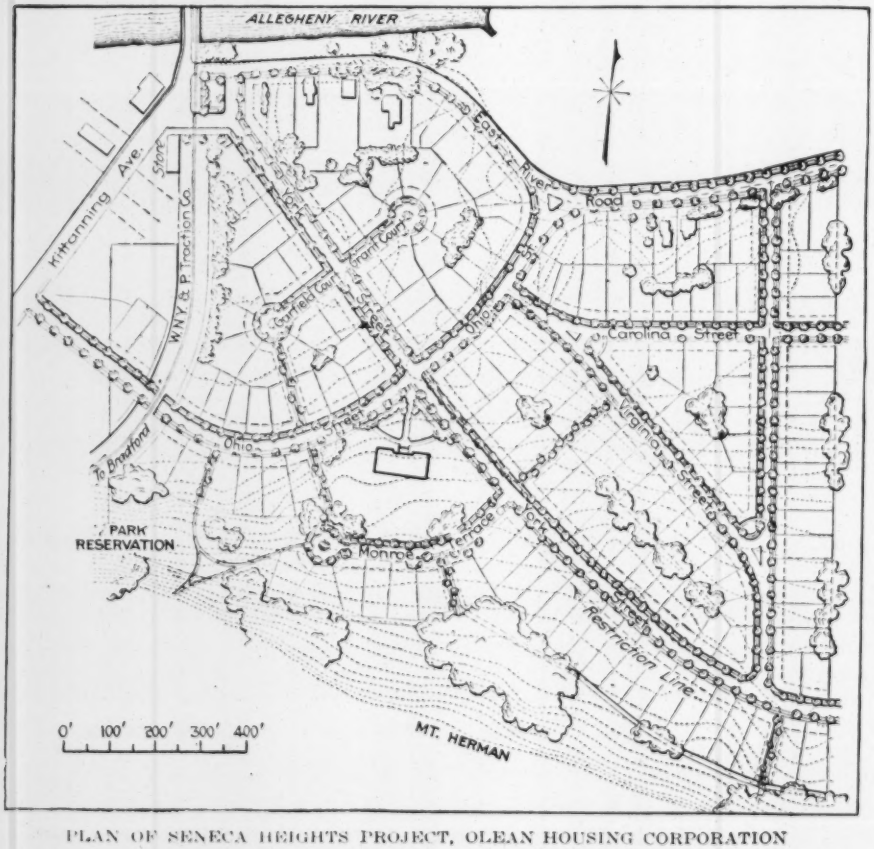
Housing Project at Olean, N. Y.

By John Nolen
Town and City Planner, Cambridge, Mass.

THROUGH the sponsorship of the Chamber of Commerce of Olean, N. Y., the Olean Housing Corporation has undertaken to provide well-designed houses on a layout embracing the best principles of town planning. E. W. Fitzgerald, secretary of the Chamber of Commerce, was instrumental in securing an advantageous site of about 40 acres extending from the foot of Mount Herman down to the south bank of the Allegheny River. The area has been named Seneca Heights, and is less than a mile from the business section of Olean.

In the grading scheme that has been prepared the steep hillside surface has been taken care of to assure as easy gradients as possible for the streets. A main avenue 50 ft. wide has been laid out southeasterly across the site. A public square has been provided at the junction of this avenue and Kittanning Ave., and midway on the estate a commanding position has been determined on for a proposed school. While the main thoroughfares are 50 ft. wide, the subsidiary streets are 42 ft. wide, and without exception all have planting strips 6 or 7 ft. wide for rows of trees. A feature of the plan is the grouping of residences around circular street terminations, which will give an air of homelike seclusion and quietude to the localities. A convenient access for pedestrians across very steep blocks inaccessible for vehicles is provided by footpaths with steps and rows of flowering trees. The lots are of varied sizes—from 50 to 100 ft. in width and 80 to 150 ft. in depth. No alleys are provided, but on the rear lot line of the blocks rows of trees will screen the backs of the houses.

The scheme is not intended to be a housing effort for any one class, but rather an endeavor to place well-designed houses in good surroundings within the financial reach of the average man. About 140 houses are to be erected. Evidence of the spirit of the undertaking is shown by the action of the Housing Corporation in purchasing houses and lots outside their area to open up appropriate and dignified approaches to the estate, the main lines of which will radiate from the city thoroughfares of Olean. The writer has been responsible for the development of the design. The architectural planning of the residences is in the hands of A. C. Bossom, architect, New York City.



PLAN OF SENECA HEIGHTS PROJECT, OLEAN HOUSING CORPORATION

Broader Education for Engineers Favored

In connection with the conference on employment and education held by the American Association of Engineers Nov. 12, a brief questionnaire was sent to educators and engineers asking for their opinion as to whether engineering, legal and other professional college courses should be preceded by one or two years of general collegiate training. Out of the 154 replies received, 99 were in favor of two years of general education, 43 were in favor of one year and only 12 were opposed to any general collegiate training in addition to the professional course. These figures expressed in percentages are: 64 per cent in favor of two years and 28 per cent in favor of one year, a total of 92 per cent who are in favor of at least one year of general education. Out of 154 engineers who replied, 54 were deans, professors or instructors in engineering colleges and the balance was made up of consulting engineers, chief engineers and other engineers. No statement is made as to the distribution of votes received from the educators.

The Use of Phosphoric Acid in Water Softening

Causticity Removed and Softened Water Carbonated With Minimum of Residual Hardness and After-Deposits

PHOSPHORIC acid is being tried on a large scale at the Columbus softening and purification works to produce a fully carbonated stable water and to eliminate any residual causticity caused by the lime-softening process. Tennessee rock phosphate is used to make the phosphoric acid. It is boiled with sulphuric acid in one of the alum boiling tanks. Phosphoric acid and calcium sulphate are produced. The latter is practically insoluble and separates from the solution, leaving a clear phosphoric acid which is fed into the water at the rate of about 0.7 grains per gallon.

The argument and line of experiments by which C. P. Hoover, chemist in charge, arrived at the use of the phosphoric acid treatment is as follows:

The normal carbonates present in a lime-softened water form incrustations on the sand grains in filters, thus increasing the size of the sand. At Columbus the sand has increased in effective size from 0.42 mm. to more than 1 mm. The incrustation also causes the sand grains to become cemented together, forming hard lumps. Details of experiences with after-deposits at Columbus, Grand Rapids and McKeesport were given in a series of three articles in *Engineering News-Record*, May 3, 10 and 17, 1917, pp. 250, 304 and 351.

At the Columbus plant the filters are being rebuilt at a cost of $20,000, as the holes in the strainer plates have become so stopped up with carbonate that it is almost impossible to force water through the filter. Columbus has not had much trouble with after-deposits in the pipes and meters, but what has occurred is increased when it becomes necessary to conserve the use of soda ash.

The first investgations toward working out a practical method of eliminating the difficulties were along the line of colloidal chemistry. Early experiments indicated that the solubility of calcium carbonate depended upon whether it was precipitated in a crystalline or colloidal condition. Calcium and magnesium carbonates in the former state are soluble to the extent of 37 p.p.m., whereas the colloid of these carbonates is soluble to more than 100 parts and colloid precipitates when the water is high in magnesium, or is muddy.

In order to produce a lime-softened water that would be stable the first method which suggested itself was to carbonate the water with CO_2. There are a number of ways that the carbon dioxide may be produced, but the ones which were given particular attention were as follows: (1) Burn the lime sludge from the settling basins, producing lime and CO_2. (2) Treat the lime sludge from the settling basins with sulphuric acid, producing calcium sulphate and CO_2. (3) Calcine sodium bicarbonate, producing sodium carbonate and CO_2. (4) Treat soda ash with sulphuric acid, producing sodium sulphate and CO_2, then roast the sodium sulphate in a furnace with slack coal and limestone, producing sodium carbonate which could be used in softening.

By carbonating the water, the normal carbonates are put in solution and there is no reduction in hardness. Under normal conditions this objection is not so serious, but during certain periods of the year, when the precipitates of calcium and magnesium are necessarily colloidal, causing the alkalinity or temporary hardness of the softened water to be high, it is desirable that these carbonates be removed by precipitation, thus reducing the hardness of the water, rather than be dissolved by carbonation, leaving the hardness unchanged.

Experiments were also conducted to determine the advisability of neutralizing the normal carbonate with sulphuric acid. This was effective, but was more objectionable than the carbonic acid because by this process temporary hardness is converted to permanent hardness.

Silicic acid was tried but the results were not very promising. However, excellent results were obtained by filtering lime-softened water through porous silica gel, as prepared by Dr. W. A. Patrick, Johns Hopkins University.

Boric acid, oxalic acid, tartaric acid and phosphoric acid were next tried and a great deal might be said of the results obtained by each of these acids but Mr. Hoover came to the conclusion that as a finishing treatment for lime-softened water the phosphoric acid is the best and most economical treatment tried. When enough phosphoric acid is added to lime-softened water to combine with any caustic alkalinity that might be present in the water, and with one half the normal carbonates of calcium and magnesium, a reaction results which produces tri-calcium phosphate, which is insoluble and readily settles from the water, and CO_2, which carbonates the remaining quantity of normal carbonates. By this process half of the carbonates are removed, thus reducing the hardness of the water; the balance of the carbonates are carbonated, thus producing a stable water.

In coagulating muddy water, such as the Scioto River water during flood times, better results are obtained with coagulants when the water is treated with enough lime to soften the water and an additional amount is added sufficient to give the water a caustic alkalinity. This caustic alkalinity must be neutralized before the water is filtered and phosphoric acid can be used for this purpose also.

Salary Committee Makes Final Report

In its final report, dated Dec. 6, 1920, Engineering Council's committee on classification and compensation of engineers, of which Arthur S. Tuttle was chairman, makes the following recommendations:

1. That Engineering Council urge the appropriate congressional committee to take favorable action in the matter of providing for an immediate increase in the compensation of the engineering staffs of the federal government and to base this action, in so far as practicable, upon the compensation suggested by your committee on classification and compensation of engineers.

2. That such committee as may hereafter be constituted, be instructed to confer with a similar committee of the American Railway Engineering Association for the purpose of bringing about the acceptance of a common standard for the classification of engineers.

3. That owing to its vital importance the work of this committee be continued by some suitable agency.

4. That the investigation to determine the relation between engineering charges to cost of work supervised be continued by such committee as may henceforth take over the work of this committee.

5. That the present committee on classification and compensation of engineers be discharged.

The continuance of the work of the committee has been referred to the American Engineering Council of the Federated American Engineering Societies.

Oversize Construction Plant Demonstrates Value

Automobile Body Factory at Cleveland, Ohio, Completed in Quick Time by Concentrating Equipment for Peak-Load Construction

PLANT concentration solved the problem of placing large volumes of material—with railway transportation disorganized—last summer in constructing the immense manufacturing plant of the Fisher Body Ohio Co. With interrupted railway service, there were combined a jurisdictional strike, a long period of rainy weather and several inundations of the site by a local stream. All delays due to these causes were met and a planned-time schedule maintained by assembling equipment in large amounts not only for placing materials in the structures but also for transporting materials from factory to the work and in some cases for moving raw materials to the factory for fabrication.

Governing Quantities and Dimensions.—The operation involved the construction of seven buildings occupying about 15 acres of a 45-acre site near the eastern limits of the city of Cleveland, Ohio. The main dimensions and the structural character of the several buildings are indicated on the accompanying plant location map. A maximum over-all dimension of 2,500 ft., had to be covered in placing materials. These materials comprised, as main items, 50,000 cu.yd. of concrete, 3,000 tons of reinforcing steel and 3,000 tons of structural steel. Brick, lumber and other material were counted by the trainload. There were for example 150 carloads of treated wood blocks for shop floors, sufficient to pave five miles of ordinary city streets. Indeed, the carload was the least unit by which the transportation volume of even minor materials could be estimated.

With materials in trainload volumes to be placed in structures extending 2,500 ft. and covering an area of 500,000 sq.ft., the construction problems were: (1) To bring the materials to the site, and (2) to assemble them into structure on the site. Construction was a transportation and handling problem and not a problem of fabricating a complex structure. With the nature of the construction problem recognized, a knowledge of railway conditions as they existed early in 1920 made it very clear that rail movement of materials to the site, if left to its natural course, would not be accomplished and so far as accomplished would be irregular in time, order and volume. Means to meet the conditions comprised close management of traffic movements, provision of equipment to aid the railways, and provision of a construction plant capable of a high-peak load. Such means were adopted. Conditions more difficult than were anticipated were met in this manner. The planned construction period was not exceeded.

Development of Site.—Water was the principal natural obstacle to the development of the site. A stream crossed the property. Its tortuous channel overflowed whenever there was rain and the area flooded by a moderate rise was about 30 acres. Ultimate diversion

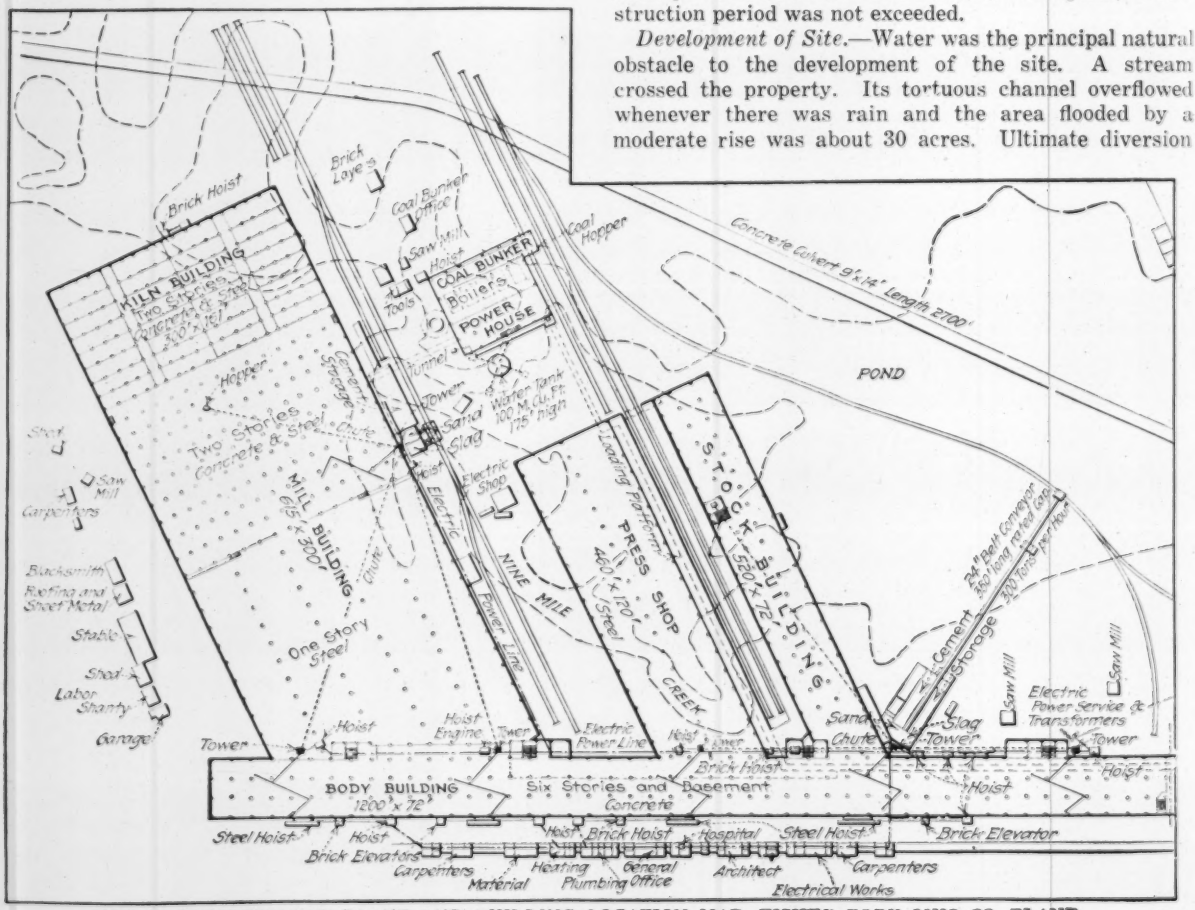


FIG. 1.—CONSTRUCTION PLANT AND BUILDING LOCATION MAP, FISHER BODY OHIO CO. PLANT

through the 9 x 14-ft. concrete culvert, indicated on the plant location map, was planned, but meanwhile, to allow work to progress, a temporary diversion channel parallel to the culvert had to be provided. As grading and stream diversion were begun at the same time there was a period when flooding could not be avoided. One of the floods, occuring June 16, 1920, is illustrated. They were a serious obstacle to progress during the first three months.

Grading was begun one week after signing the contract on March 16. About 100,000 cu.yd. of earth had to be cut from the high areas and filled into the low areas. The season was extremely wet. In April and May there was rain followed by overflows of the creek on over half of the days. To retard further the operations interrupted by wet weather, there was a jurisdictional strike between hoisting engineers and shovel runners. These delays were particularly troublesome because, as indicated, about one-half the area had to be excavated and the material spread over the other half, which allowed no room for unloading construction materials until the grading was completed. If, therefore, the grading time schedule was prolonged, the delay would be carried forward into the building construction operations.

Concentration of plant was adopted to meet the difficulty. For bulk movement a 3½-cu. yd., 70-ton steam shovel, a locomotive and train of 12-cu.yd. air dump cars handled excavation to fill; at the fill a second locomotive and a spreader maintained the dump. Less conveniently-reached yardages were handled by ¾- and ⅞-cu.yd. revolving shovels, seven of which were in operation at the peak of the excavation. Trains of 2-cu.yd. cars and 3-ton gasoline locomotives moved the bulk of the small shovel excavation over the 2-mile system of narrow gage railway. At isolated points the steam shovels loaded to motor trucks and dump wagons. Elevator pits, machine foundations, tunnel emplacements, etc.., were excavated by a locomotive crane and clamshell wherever they could be reached from the main tracks. At other points a walking crane was employed. The outfit was extremely large for the volume of earth movement, but, despite delays, it completed the work within the time schedule, which was the object sought.

Development of Concreting Plant.—Concrete mixing and placing was the governing operation in building construction. There were placed some 3,000 tons of structural steel, but it was mostly one-story work.

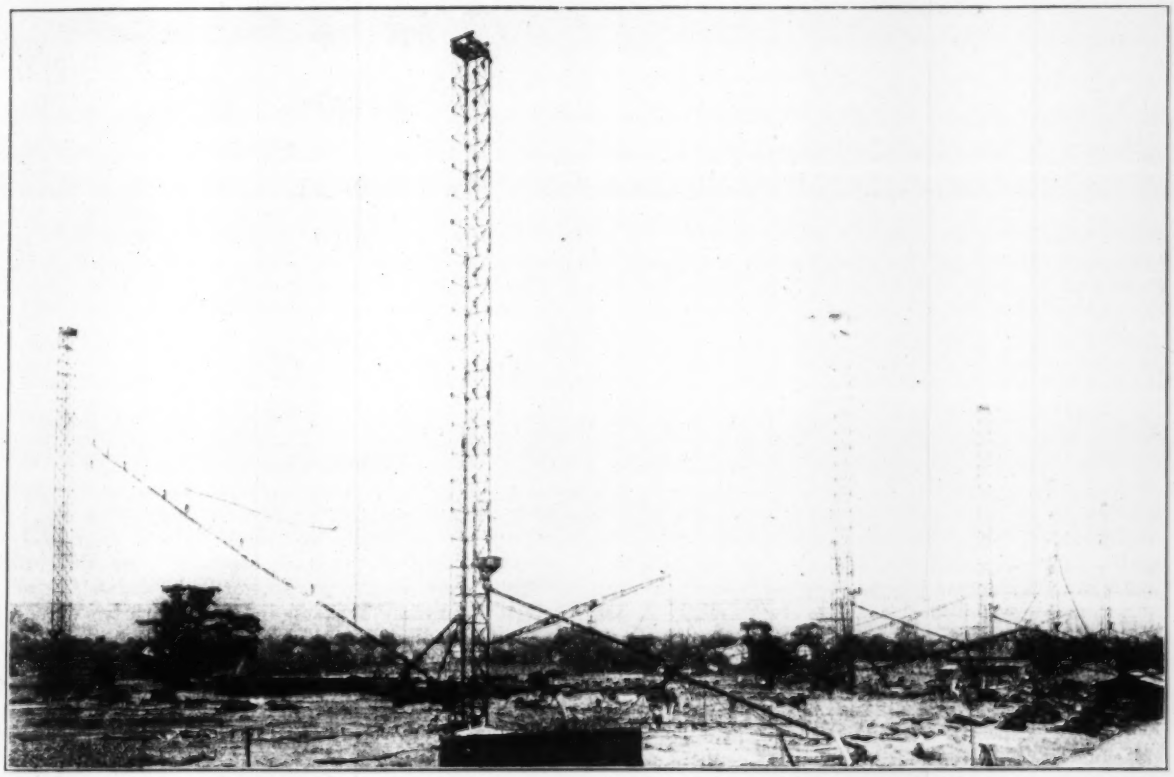


FIG. 2—SIX-TOWER, TWO-MIXER CONCRETE CHUTING PLANT SERVED ALL BUILDINGS

The concrete work, however, involved 50,000 cu.yd., including 3,000 tons of reinforcement. Structurally, the work was ordinary. The body, stock and mill buildings are of the flat-slab type, and the kiln building (first supported floor) is of tin-pan construction, with 2-in. concrete slabs cast in advance of placing the pans so that a flat ceiling effect was produced.

While the bulk of the concrete to be placed was in the body building, a yardage equal to an ordinary operation was required for the stock building, and almost double that amount required for the mill and kiln buildings, the concrete portions of these latter two buildings being 600 ft. from the body building. In order to accomplish the desired result of reaching all this work, it was decided that there should be two distinct and separate plants each with a one-yard mixer and over-head bins for bulk material. Along the rear of the body building were erected five steel towers, 160 ft. in height, at intervals of about 230 ft.

Plant No. 1 was located at the junction of the stock

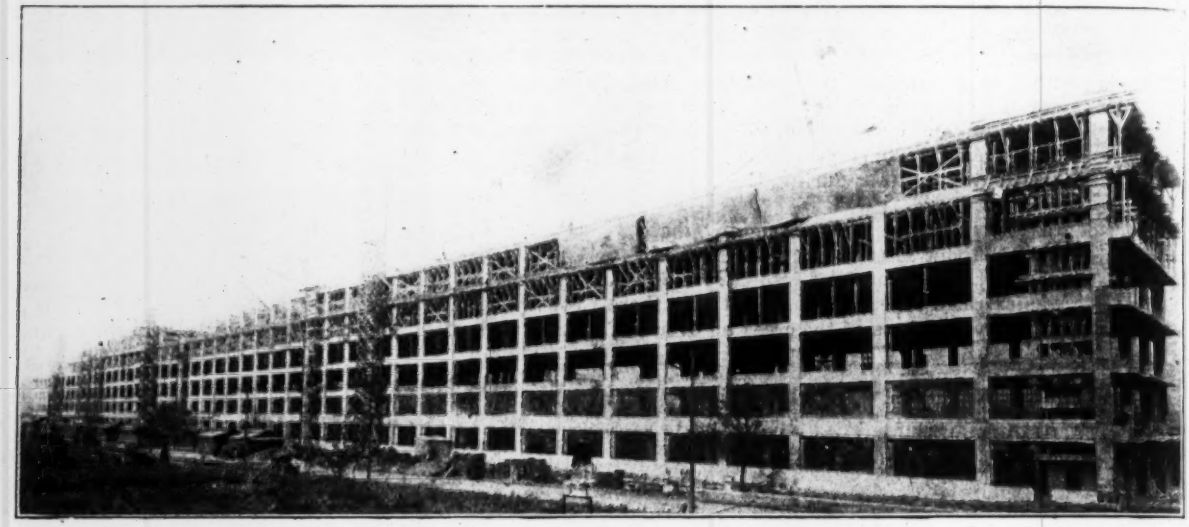


FIG. 3—BODY BUILDING, 1,200 × 72 FT., UNDER CONSTRUCTION

and body buildings, and served the three easterly towers as well as a line chute to the rear of the stock building, from which a small portion of the yardage of this building was wheeled in buggies. Plant No. 2, with a 200-ft. steel tower, was located in proximity to the yardage of the mill and kiln buildings, and served, through two 400-ft. chutes, the two westerly towers of the body building, as well as a line chute to the kiln building, from which the yardage of this building was wheeled in buggies. The concrete delivered by the three easterly towers was hoisted in the center tower and shot to the easterly and westerly towers through a 230-ft. line chute, except when the work of concreting was being carried on within reach of this main tower, at which time it was discharged into the counter balance chuting equipment as was the case, after re-hoisting, in the auxiliary towers.

Plant No. 1 differed from Plant No. 2 in the respect that the railroad track was 350 ft. distant and all the material was handled on a 24-in. belt conveyor running with a rated capacity of 300 tons per hour. The stone and sand were fed onto the belt from hoppers underneath the track into which the contents of the gondola cars were dropped. The cement was also handled on this belt and an ingeniously arranged threeway device was located at the top of the belt by which the stone and sand were thrown to the right and the left and the cement went straight forward into a chute leading back through the roof of the cement house. Plant No. 2 was supplied with stone and sand (from individual hoppers underneath the track) by bucket conveyors each designed for handling its particular commodity, while the cement was trucked in from an elevated spur track at the end of the cement house.

Other Plant Features

While criticism was made of the size of this installation the satisfactory results obtained—from the standpoint of efficiency and speed—demonstrated the utility of size, as exemplified in such a record as 1,065 cu.yd. of concrete placed on the superstructure of the body building, with one plant running eight hours and the other nine hours, or a total of seventeen plant-hours, averaging in excess of 61 cu.yd. per hour per plant, thus requiring a carload of bulk material every fifteen minutes.

The construction plant was electrically operated throughout. All the concrete hoisting towers were operated by 100-hp. single-drum, electric engines, with a capacity of 6,000 lb. at a speed of 400 ft. a minute. The mixers were driven by 20-hp. electric motors, the belt conveyor by a 30-hp. motor, direct connected, while the bucket conveyors were driven by a 25-hp. motor through a line shaft with an independent friction clutch for each conveyor, thus elminating the necessity for operating both when only one was required, and also permitting the repair of one while the other was in operation. The cement bags, of which there were about 500,000, were shaken satisfactorily by two electrically driven, rotary bag shakers, and baled with two standard hand-operated baling machines. Double drum, 55-hp., electric engines were used for the brick and steel hoists, there being six of each, one drum being assigned to the steel hoists, and the other handling the brick hoist, being lagged up to develop the increased speed desired for the latter. Single cages of two-wheelbarrow capacity were used for the brick elevators, while the reinforcing steel was handled by self-unloading so-called aeroplane-type hoists.

Transportation Arrangements.—Hardly had the excavation reached a point where work could proceed on the foundations when the switchmen's strike demoralized shipments, so as to necessitate radical steps being taken to get equipment, etc. onto the job. Expressing and trucking long distances where freight had previously been arranged for was resorted to, and in many instances the manufacturer was provided with the raw materials. In addition, the finished product had to be transported to the job. This obstacle had not yet been removed when the coal movement to the Northwest (of which Cleveland was the heart) started. The Interstate Commerce Commission issued orders prohibiting the use of open-top cars for shipments other than coal, thus throwing a vast amount of commodities normally handled therein into box cars, causing a heavy shortage of these cars also. It was, therefore, evident that if the job was to proceed at all something other than railroad equipment must be depended upon.

It was at this time that full trains of gondola and box cars were purchased and a privately operated locomotive arranged for—the former to handle sand from the pits 12 miles distant, the box cars to bring cement, and the latter to take care of the switching within the plant.

The permanent sidings for service to the plan constitute approximately a mile of standard-gage track, while approximately three-quarters of a mile of additional track was built for temporary use during construction.

High Construction Speeds.—By the time the concrete of the rear buildings had been got out of the way, which effort was made in order that the steel superstructure and brickwork might progress while the body building was being concreted, and the large amount of extra foundation work not previously anticipated was finished, Oct. 1 was reached. It was during the early part of this month that the concreting of the first supported floor of the body building took place and between that date and the first week of December, at which time the roof was poured, the entire superstructure of this 1,200-ft. building was concreted. The speed averaged approximately ten calendar days per floor, comprising in excess of two acres. Two sets of slab, and one set of column and beam forms were used. Incidentally the brickwork on this operation (40,000,000, face and common) and the sash and glazing (over 500,000 sq.ft. of the former and 250,000 lights of the latter) so closely followed the concrete work that it was necessary to delay on the sixth story until such a time as the roof slab was sufficiently set to remove the forms.

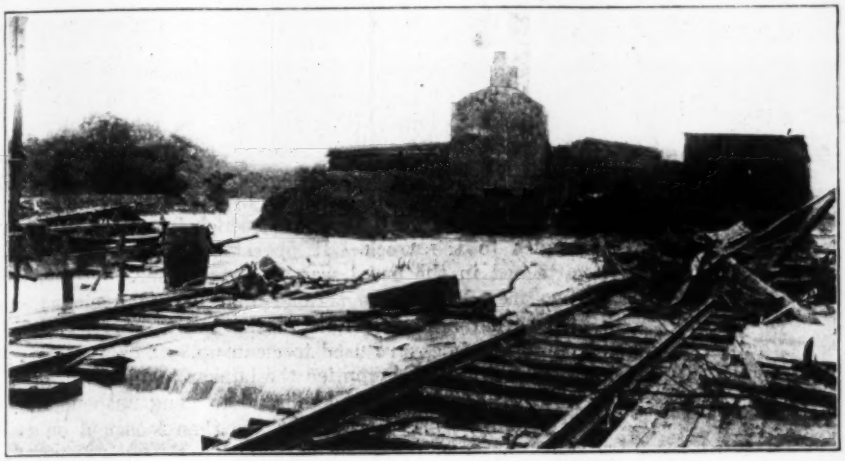


FIG. 4—MATERIALS STORE YARD DURING FLOOD OF CREEK TRAVERSING THE CONSTRUCTION SITE

The entire project was designed and supervised by Albert Kahn, as architect and engineer, while the actual construction was done under a general contract with Thompson-Starrett Co.

United States Reclamation Service Projects

The net construction cost of the reclamation projects completed or under construction up to June 30, 1920, was $125,000,000 or $25,000,000 less than the value of crops grown in 1919, according to the nineteenth annual report of the U. S. Reclamation Service, as summarized by Arthur P. Davis, director.

Enormous Power Program in California

"The future of California is circumscribed by the extent to which it develops power," said Wigginton E. Creed, president of the Pacific Gas and Electric Co., speaking at a recent meeting of the San Francisco Section, Am. Soc. C. E. "The big problem to be solved in power development is finding the money for the enormous construction program that must be undertaken. A rate of increase of 100,000 hp. per annum will no more than meet present needs and take care of growth at the present rate." Taking the cost of development at $350 to $400 per horsepower, he estimates that there will be needed an annual investment of $40,000,000 for some years to come. If California takes advantage of its physical opportunities, Mr. Creed believes that there will be a demand for the investment of between $500,000,000 and $800,000,000 in the next ten years.

The relative extent to which the chief sources of energy are now used in supplying power in California were quoted as follows: Oil, 64 per cent; hydro-electric power, 21 per cent; coal and coke, 16 per cent. Too much independence has been placed on oil, Mr. Creed said, because the oil industry has reached out and assumed more of the industrial burden than it can permanently carry. If the excessive burden on the oil industry is to be relieved so that oil resources may be conserved for other uses, Mr. Creed pointed out that hydro-electric power must be developed at a still greater rate than an increase of 100,000 hp. per annum required to take care of present needs.

Concrete and Steel Harbor Towers

During the war there was a good deal of general comment in the English papers concerning some curious reinforced-concrete cellular towers which were under construction at Shoreham. These were huge structures made up of hollow concrete boxes and the popular suggestion was that they were caissons to raise sunken vessels. It has now been stated that they were built as the basis of permanent islands in the English Channel and were to carry high steel towers. It was the intention to float the concrete structure out into the Channel, fill the hollows full of concrete to sink to the bottom, at which time the steel tower would protrude above the water and form a site for coast defense work. The total weight of the concrete structure is about 10,000 tons and the tower about 180 ft. high. The buoyancy of the hollow blocks was such that they drew when afloat only about 4 ft. of water. One of these structures has recently been towed from Shoreham to Portsmouth, where it is to be sunk adjacent to one of the lighthouses. While the structure can be used for gun mounts as it was originally intended, at present it is merely to be used to serve as a navigation mark.

HINTS FOR THE CONTRACTOR

Slip Scraper With A-Frame Used for Unloading Rock and Sand

By W. B. Albertson
Construction Superintendent, California Highway Commission

A LIGHT, portable device for reducing the labor of unloading rock and sand from railroad cars has been developed by the writer and used on California highway construction work. It has been particularly satisfactory in the South during the summer, when it is almost impossible to keep men shoveling rock out of cars in the hot sun. The capacity of the outfit varies with the men, the record for speed being 55 tons of gravel unloaded in 70 min. This pace is too fast for the men to keep up, however, even if enough hauling equipment to handle the materials is available.

The device consists essentially of a timber A-frame,

UNLOADING GRAVEL WITH A SLIP-SCRAPER

attachable to the side of the railroad car, a bunker suspended from this by chains, and a gasoline engine operating a cable passing through a sheave in the A-frame to a slip scraper in the car. The A-frame is made up of 6 x 6-in. posts, 20 ft. long, with a 6 x 8-in. cap, 5 ft. long. Cap and posts must be securely bolted together and knee braces are required at the corners to carry the side strain. This side strain could be taken care of by guy wires, of course, but these were found to be hard to keep anchored and more or less in the way and so were entirely eliminated.

The frame is set up with its foot about 3 ft. from the rail, which leaves it in an almost vertical position when resting against the side of the car and yet permits of car clearance, by leaning the frame back, without changing the footing. The footing is anchored to the track by a chain hooked to the under side of the rail.

From each end of the A-frame cap, guy wires are run over the car and down to some convenient point on the bottom of the car body where they are attached. These guys are not carried straight across the car but are spread out to take some of the side strain that results when the scraper is worked in one end of the car. The part of each guy which remains permanently attached to the cap, has in its lower end a ring or loop from which a block and tackle is run to the anchorage. One man can pull the guys tight enough to bind the A-frame firmly against the other side of the car body.

The bunker, 6 x 7 ft. in plan and with sides and ends high enough to hold 2½ tons when hung at an angle of about 33 deg., is slung from the cap by means of ½-in. chains. These are attached to the bunker at its outer end and by adjusting their length with grab hooks the slope of the hopper bottom can be suited to the material handled. This slope is set so the material will run out without being raked or shoveled. The other end of the bunker rests on the edge of the railroad car, being fastened there by hooks which prevent it from slipping either way. The door is made the full length of the bunker and hinged at the top. It is held shut by hooks so located that they can be released by the upward blow of a shovel. Ordinarily the truck driver tends the bunker gate.

Motive power is provided by a single-drum hoist operated by a 6-hp. gas engine which is set out at right angles to the track. It operates a ⅜-in. steel cable attached in the usual way to the scraper. Ordinarily two men handle the scraper and one man cleans up the corners. However, if the bottom is rough or hoppered, two men are used to clean up.

When the car is emptied the bunker is unhooked from the side of the car and allowed to hang suspended by its chains. The rope blocks are then loosened on the guy lines and the A-frame leaned back away from the track, in which position it is easily held by a 2 x 4-in. timber brace, while a new car is spotted. The entire operation of changing cars ordinarily requires only about fifteen minutes.

No Special Plant Needed to Handle Bulk Cement, Says This Contractor

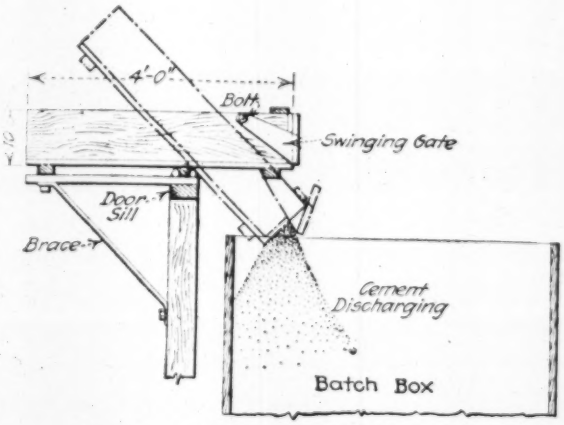
ACCORDING to Arthur Loeb, vice-president, Keystone State Construction Co., Philadelphia, Pa., no special plant or equipment is necessary in handling bulk cement. In a recent issue of the *Contractors' Atlas*, Mr. Loeb explained the method used by his firm in handling bulk cement for a concrete highway job at Townsend, Delaware.

The cement storage house is 150 ft. long and 20 ft. wide, with a capacity of 20 cars, or over 4,000 barrels. It is substantially built to withstand moisture or dampness. It has a concrete foundation and a concrete floor at the ground level. It is located between the railroad siding and industrial tracks.

The doors on the railroad side are fixed so that cement can be discharged through a chute from the car directly into the cement shed. The upper end of the wooden chute used is flared, with a cloth held over the top to prevent excessive dusting. This chute is located about breast high so that the cement can be easily shoveled into it. When unloading progresses to such a point where it is inconvenient to shovel into the chute cement is stored in the house with the aid of wheelbarrows. Horizontal struts and center posts of the cement shed at the door level support the wheeling

runway, which can be shifted at will. When the cement shed is filled to capacity the cement lies level with the door sills at each side of the house. For measuring into batch boxes, the following method is used:

The doors of the cement house are so located as to be at the proper spacing for the batch boxes on the industrial cars. The sills of the doors are located well above the track level and on each sill there are two



DETAIL OF TILTING MEASURING BOX

tilting boxes, each holding 4 cu.ft. of cement—the proper amount for the four-bag batch that was used on the job. These measuring boxes are filled by means of hand pails. When a box is filled a slight pull tilts the box and discharges its contents to the automatic gate located at the outer end of the box.

Railroad Type Shovel Swung End for End In Shale Quarry

THE method used in turning end for end a heavy shovel of the railroad type operating in a shale quarry is told in a recent issue of *The Excavating Engineer*, by E. J. Strock, superintendent of the Colorado-Portland Cement Co., Portland, Col.

In working the shale quarry each cut was carried lower than the preceding one, giving the floor a staircase appearance and making it impossible to have any great width of level floor on which to turn the shovel. The shovel was backed to within its length of the place where the new cut was to begin, chains were disconnected, and the rear end of the shovel jacked up.

The rails had been bent to a curve, the radius of which was the distance between truck centers. These rails were bridled together and set loose on ties laid at right angles to the length of the shovel, but curved in the arc of a circle. The rear truck was then swung at right angles to its usual position and lowered to the rails. The dipper hung free in front.

The rear end was then moved around the curved rails until the front truck jammed. Next the front end of the shovel was jacked up, the jack screws following closely in case a jack failed. When clear of the rails the front truck was swung around in the same direction as the rear was moving until the truck jammed, the short section of track fitted under the truck in its new position, the truck lowered and the rear end again pinched over. This was repeated until the shovel was facing in a direction directly opposite to its original one.

Steam Compressors Simply Converted to Electric Drive

By Donald G. Coombs
Office Engineer, Braden Copper Co., Rancagua, Chile

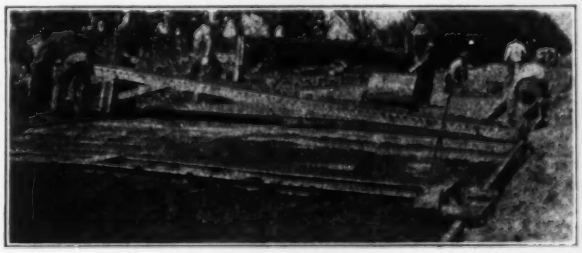
SIMPLE alterations successfully converted into motor-driven machines for smelter purposes, a number of old 14 x 12 in. straight line steam driven air compressors previously employed in mine tunnel excavation. The change was accomplished by removing the steam piston and both the air and steam end piston rods and replacing them by one rod from the air end to the cross head. The stuffing boxes of the steam cylinder served as bearings for the new rod, and with the valve rod disconnected the machine was ready to be belted to a motor. The compressor fly wheel was 8 x 64 in. and it was belted to the 10-in. pulley of a 900 r.p.m. 50 hp. a.c. motor by a two-ply 8-in. leather belt. The pulleys are on about 15-ft. centers and no idlers are used.

Contrary to expectations no belt troubles have been experienced due to the narrow uncrowned faces of the fly wheels, although the blow-off is set at 110 lb. and the compressors are operating at an elevation of 5,100 ft. above sea level. Three of these machines have been running for nearly a year with no more trouble or expense than the regular motor driven type compressor. Since, previous to the change in drive, the direct labor and material charge was $40 per 10-hr. day per machine, using an 80 hp. vertical fire tube boiler with a fair grade of briquetted coal at $32 per ton, the saving effected has been considerable. The method of making the change was the idea of Wm. Dunne, shop foreman, Caletones. The writer was general foreman.

Gravity Conveyor Speeds Up Laying of Brick in Road Work

By F. W. Epps
Bridge Engineer, Kansas Highway Commission

THE device illustrated herewith, for delivering bricks in highway construction to the workman, runs on the tracks which constitute the forms for the base of the monolithic brick pavement. One end is elevated by a frame which is braced to the main part of the con-



BRICK CONVEYOR IN OPERATION ON KANSAS ROAD JOB

veyor bricks being delivered to the workman by means of mechanism operated by gravity.

The device can be changed to accommodate difierent widths of readway by shifting the frame at the upper end. Many miles of monolithic brick pavement in central Kansas have been laid in this method which has the double advantage of being economical and simple.

Letters to the Editor

The Proposed National Public Works Department

Sir—In your issue of Dec. 30, 1920, p. 1273, there appears a very clear "Analysis of the Proposal to Establish a National Department of Public Works," by Lieutenant-Colonel C. O. Sherrill. The writer is in hearty accord with the sentiments expressed so far as they relate to the Corps of Engineers, U. S. A. To curtail or hamper in any way the activities or authority of this splendid body of technically trained men on public works of the country would be a calamity. It is upon these great works that the young graduate of the Military Academy acquires the practical experience in the handling of men and materials that is so essential to his efficiency in the theater of modern warfare.

The magnificent record made by the Corps of Engineers in France was due to the fact that the men in responsible command were experienced in great construction works—on our rivers, harbors, Panama Canal, etc., and the writer believes that the sphere of their operations should be extended, that they should exercise supervision over highway construction when same is aided by federal grants, that they should have a certain period of training in the transportation departments of our large railway systems, and some experience in large industrial concerns.

St. Louis, Jan. 4. F. G. JONAH,
Chief Engineer, St. Louis-San Francisco Railway Co.

An Analysis of the Proposal for a Public Works Department

Sir—Because the writer was formerly an officer of the National Public Works Department Association numerous suggestions have been made by public works department supporters that he submit reply to an article which appeared in your issue of Dec. 30, p. 1273, entitled "An Analysis of the Proposal to Establish a National Department of Public Works," by Lieutenant-Colonel C. O. Sherrill, Corps of Engineers, U. S. A.

For some weeks prior to its appearance the writer had knowledge that the article in question was being prepared. He is advised that it has been carefully reviewed by the chief officers of the corps. It may therefore be accepted as an authorized pronouncement, if not a corps symposium. Coming with such authority and under the authorship of one of the ablest engineers in the corps, as well as one of the finest gentlemen in the army, the article is most opportune. It sets forth clearly, for the first time since the public works movement was revived, not only the attitude of the Corps of Engineers but also its concepts as to the fundamentals of organization. The advocates of the Jones-Reavis bill, or any equivalent instrument, may be quite content with the latter. It is rare that any party to a controversy reveals misconception of fundamentals so ingeniously.

It would be profitless now to make reply to the points raised in this article. Congress has recently created a joint committee, which in the course of its investigations into the executive departments would presumably cover the whole subject of public works and the relation of the Corps of Engineers thereto. All parties will have their day in court and the public will have the benefit of facts rather than of arguments. This opportunity to secure an unprejudiced hearing should be welcomed by all concerned, and while the writer has no expectation of taking part in the proceedings he is nevertheless prepared to abide genuinely by the findings of this joint committee of Congress.

In the meantime it will be conducive to a proper understanding of the matter if the civilian engineers will concede that it is natural for the Corps of Engineers to oppose a measure which it confidently, though mistakenly, believes will mean its destruction. In the conduct of broad propaganda in which existing conditions must be criticised it is difficult, if not impossible, to avoid the appearance of personal unfriendliness toward those whose doings are regarded unfavorably. The public works matter will now, so to speak, be carried into court, where actual evidence rather than special pleading will be the order of the day. Between parties there is an honest difference of opinion. Let us lay our evidence before the tribunal without derogation of motives.

M. O. LEIGHTON,
Consulting Engineer.

Washington, D. C., Jan. 4.

Useful Dodges in Surveying

Sir—In the interesting articles for the "Average Engineer" which you are now publishing, one by H. L. Thackwell in the issue of Dec. 16, p. 1164, seems to call for some comment.

Under paragraph 7, Mr. Thackwell describes a method for taking topography which is not a short cut but rather a description of a method adopted by engineers who sought better results than those obtained by straight transit and stadia work. The writer believes that for taking topography, nothing yet invented can take the place of the plane table, properly handled Mr. Thackwell has merely moved his office drafting force to the field, increasing the cost of the field party without obtaining any increase in output.

In Mr. Thackwell's method, computation of distance and elevation is made by the slide rule. This operation became unnecessary upon the invention of the Beaman stadia arc. The use of vertical angles is avoided by the use of this standard attachment, which also carries a scale giving the correction needed to reduce observed stadia distances to horizontal.

In the method described in the article in question, the angle observed by the transitman is called out to the recorder, who plots it. It is evident that this introduces another operation and at least a personal factor error in the plotting. Such an error is eliminated by the direct observation of the angle on the plane table sheet.

The speed claimed by Mr Thackwell is not equal to that of a plane table party. With two rodmen, the writer has averaged 1,000 acres of rolling prairie land daily, using 1-ft. contours on a scale of 2,000 ft. equal to 1 inch.

Under the method advocated by Mr. Thackwell, there is a division of responsibility between transitman and recorder. The recorder is not able to vizualize the country, has no choice in the matter of the location of the rod, and the resulting map is apt to be "wooden." On the other hand, in plane table work, since the responsibility is fixed upon the plane table operator alone, the credit for good work is fixed with equal exactness.

L. B. ROBERTS,
Division Engineer, N. Y. Water Power Investigation.

New York, Dec. 22.

Kenova and Niagara Measurements of Secondary Stresses

Sir—I have read with much interest the article "Secondary Stresses in Kenova Bridge Measured," by John I. Parcel and George A. Maney, in *Engineering News-Record* of Dec. 9, 1920, p. 1116. There is no doubt that much is to be learned, especially concerning secondary stresses, from stress measurements in existing structures, and the thanks of the profession are due to Profs. Parcel and Maney for this presentation of their results.

In view of the authors' statement "so far as known no test has been made on a structure of anything like the size of the Kenova bridge," the writer wishes to call attention to the paper in the *Proceedings* of the American Society of Civil Engineers for May, 1920, "Revision of the Niagara Railway Arch Bridge," by Charles Evan Fowler, in which an account is given of a very extensive series of tests made on that bridge.

During the summer of 1918 Prof. A. H. Fuller and the writer, under the direction of Mr. Fowler, made a very extensive investigation by means of the

strain gage, of the stresses in the 550-ft. double-deck arch bridge over the Niagara River at Niagara Falls. Stress measurements were taken on all the members of one-half of one arch, with the exception of one upper and four lower-chord members, and check readings were taken on a number of members in the other arch. In all cases readings were taken on the four corners of a member. At two upper-chord joints additional sets of readings for secondary stresses were made, as near the joint as possible, on all the members centering at these joints.

The instruments used were Berry strain gages. The gage length was 20 in. in all cases except for the readings near the joints; for these an 8-in. gage was used because the stresses are changing rapidly there and it was desired to find the maximum variation. The assumption made by the authors that the inflection point is $\frac{1}{8}\ l$ from the joint is open to question.

The loads were specially-made-up trains of known weight and were placed in position for maximum stress in the member in each case. The loads remained stationary while the readings were being taken, thus eliminating all effects of impact and variation in time of taking the readings at a point. Secondaries were not computed theoretically but were estimated by comparison with the computed values for the Hell Gate arch, which is a similar structure. The estimated values thus determined and the measured values were plotted together and compared.

It is of interest to note that secondary bending stresses were found in the top chords in a horizontal direction as well as in the plane of the arch.

Permanent gage points were placed in a number of the members so that check readings can be taken at any future time desired.

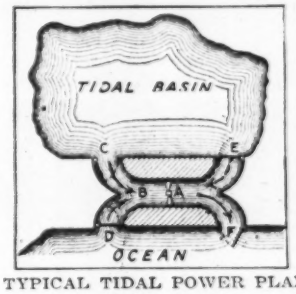
CLYDE T. MORRIS,
Professor of Structural Engineering, Ohio State University.
Columbus, Dec. 30, 1920.

Old New England Tidal Power Plants

Sir—I note on p. 1221 of your issue for Dec. 23, 1920, a description of a proposed tidal power project to be applied to the Severn River in England. From the specific periods of operation set forth it would appear that possibly the engineers are not making as full a use of the tidal flow as would be possible were a structure employed similar to that used many years ago in certain tide mills on the New England coast.

Referring to the accompanying sketch, the waterwheel at *A* is placed in a conduit *B* communicating at each end both with the sea and with the tidal reservoir. Suitable gates *C*, *D*, *E*, and *F* are provided and during the outflow the gates *C* and *F* open, supplying water to the turbine. At the same time the gates *D* and *E* automatically close. Similarly, during the flow of the tide, the gates *C* and *F* close and the gates *D* and *E* open, producing a flow through the turbine in the same direction as before.

Incidentally, electrical engineers will notice the marked similarity between



A TYPICAL TIDAL POWER PLANT

this structure and the ordinary rectifying circuit for use with electrolytic valves, suggested, I believe, by Nodon.

D. C. DAVIS.
Philadelphia, Pa., Dec. 29, 1920.

Soil as an Elastic Solid

Sir—In *Engineering News-Record*, Dec. 30, 1920, p. 1268, appears an interesting article, "Earth in Foundations Considered as an Elastic Solid," by Lazarus White. I have no criticism to make other than with that portion of the title (which I assume to have been written by the editor rather than the author) which refers to the theory of earth as an elastic solid as "new." I quote below from my discussion in 1907 before the American Society of Civil Engineers of a paper on "Earth Pressures and Bracing," by James C. Meem:

> Some time ago, after consulting all the available writings on the subject of earth pressure, and being unable to reconcile the results with his own observations, the writer became convinced that the common theory was erroneous and that no practical formula could be developed by considering earth (unless either so dry or so saturated as to flow) either as a granular or as a liquid mass, but that it must be considered as a solid body, the characteristics of which it possesses. * * *
>
> This fact is important. It is utterly inconsistent with the theory for fluid pressure or that for a fine granular mass; but it is perfectly consistent if the earth is considered as an elastic solid body. This assumption may properly be made, as a mass of earth in its undisturbed state possesses the same properties of cohesion, weight, tensile, compressive and shearing strength, as does a mass of sandstone, but in much less amount.

These quotations, with the rest of the discussion, will be found in *Transactions*, Am. Soc. C. E., Vol. LX, June, 1908, p. 27, in that discussion earth was considered as an elastic solid and discussed from many viewpoints. The experience of over 13 years since then has but more firmly convinced me of the truth of the statements then made. In fact, were soil not an elastic body much of the immense structural work which has been successfully completed in and around New York City for a number of years would have been utterly impossible.

The principle involved is so important and has such far-reaching consequences that it is difficult to understand the lack of interest in the matter on the part of many engineers, especially when it is considered that much useful information could readily be obtained on many important pieces of public work.

There are certain phases of the case to which I called attention in a discussion of a paper by H. G. Moulton, presented before the American Institute of Mining and Metallurgical Engineers, Feb. 20, 1920, and similarly in my discussion of a paper by Mr. Meem before the Brooklyn Engineers Club, Feb. 12, 1920. There are other phases also, but the nature of my connection with the Transit Construction Commission in New York City, as well as being a member of the committee, to codify present practice on the bearing power of soils for foundations, appointed by the American Society of Civil Engineers, preclude my treating of them now—though I hope to later.

In addition to my calling attention to the matter Mr. Moulton has for several years been spreading the gospel up and down the land "as the voice of one crying in the wilderness," and only of late has he been heard. I am therefore forced to the conclusion that engineers read but little technical literature.

Mr. White, with whose work I am entirely familiar, is one of relatively few engineers who take immediate advantage of any useful suggestion in engineering, and the success of his work has shown close attention to the theory and technique of the profession. Granting that soil is an elastic solid the logical thing to do, as suggested by Mr. White, and adopted for several years past in his practice, is to retain the compression to which the soil is subjected in any test imposed, and not release it, and he deserves much credit for calling the matter to the attention of the profession. There is no more sense in releasing the pressure developed by a jack or other means beneath an underpinned foundation than there would be in letting go of a rope by which one were attempting to lift a heavy weight. The effect would be the same in both cases, that is, all the work must be done over again. The close attention to these small details, many of them fundamentally important, is what marks the difference in the measure of success between Mr. White's work and much similar work done by others.

E. G. HAINES.
New York, Dec. 31, 1920.

Russian Engineering Society

Sir—It may interest you to know that the Russian Engineering Society in the United States, with permanent address at 29 West 39th St., New York City, was founded in 1918.

Since the spring of 1920 it has been affiliated with the United Engineering Society through the American-Russian committee, a body subordinated to Engineering Council and consisting of three Russian and four American members.

The Russian Engineering Society in the United States is purely a professional organization and counts amongst its 91 members many prominent Russian engineers in the United States. The society has organized its own employment bureau, the services of which are at the disposal of the prosional organization and counts among its 91 members many prominent Russian engineers in the United States. The society has organized its own employment bureau, the services of which are at the disposal of the profession.

fession.

A. PAZDZERSKY,
Secretary, Russian Engineering in U. S. A.

New York, Jan. 3.

Other Weak Retaining Walls

Sir—The article by C. W. Cook, entitled "Retaining Wall Failure Predicted" in *Engineering News-Record* of Dec. 23, 1920, p. 1217, describes a wall that is similar to one that came under our observation about a year ago.

This wall was a curtain wall about 30 ft. high, 4 ft. 6 in. thick at base, resting on piling and anchored back by rods or wire rope to concrete blocks in the bank. These anchor blocks were placed back of the angle of repose, and in that respect and in the piling at the base the design was superior to the design shown in Mr. Cook's plan "B." The builders submitted to the owners a plan evidently in accordance with the owners' ideas, as they marked on the plan that the contractors "assumed no liability for the design of the wall." No engineer's name was attached to the plan, and we therefore felt at liberty to advise the owners, when the plan was submitted to us that the wall would not stand; we advised a radical modification of the plan, requiring a considerable increase in cost. The owners however decided to build the wall as designed, and it was so built.

We recently made an examination of the wall and found that the wall had bulged in places as much as a foot, and that it had then been reinforced by groups of piles in front of the wall, encased in concrete. These buttresses were about 6 x 8 ft., 30 ft. on centers, and extended to about 8 ft. from the top of the wall, making a very ugly harbor-line frontage. The wall with its buttresses must have cost more than a correctly designed wall, and it is still uncertain as to stability.

Other parties also advised that the wall would not stand, but as the owners had been eminently successful manufacturers during the boom they apparently knew more than any one, either engineers or contractors, and as it was their own money they felt at liberty to spend it as they pleased.

Retaining walls correctly designed and built will stand. Some walls have stood when the design was theoretically incorrect. This is due sometimes to the conditions that should have been expected not having been realized. I have in mind a division wall between two sections of a reservoir, the upper section being only half as deep as the lower section. With the upper basin full and the lower one empty, the resultant pressure line falls outside the face, and the wall should overturn. But it doesn't. It has stood for 25 years and is a fine job of ashlar masonry. Why doesn't it fail? My answer is that the masonry must have been built into the shale backing from the level of the lower basin to the bottom of the upper one so that the solid shale at the back of the lower half of the wall forms a part of the structure. The design does not, however, show this. If some "congeneer" should copy the design of the wall, and the backing condition were not similar, something might happen.

It is usual in the design of a gravity dam to design it so that the resultant pressure line falls within the middle third of the base. Some years ago there was built a dam in the mountains where the resultant line fell near to the outer edge. When the attention of the engineer was called to this he built an additional triangle of masonry at the toe of the dam anchored to the first work by shear rods. This was not done throughout the entire length of the dam, but dependence was on the earth in front of the dam. It still stands. Other dams more correctly designed have gone out. In this case, the workmanship and foundation were excellent and a cutoff wall at the upper side must prevent seepage of water under the face so that the uplift is negligible. Suppose someone builds a dam according to the original design. Would the eminent engineer who designed the first dam be responsible?

I once saw a retaining wall whose base was but about one-eighth of the height. It stood for 35 years and would have stood longer had it not been undermined. Examples such as the above are dangerous, not only by themselves but for the one who copies them without knowing the modifying conditions. Supposing the wall described by Mr. Cook is filled with granulated slag well compacted. The angle of repose might be 90° and the wall might stand, to confound engineering opinion.

N. F. HOPKINS,
Pittsburgh, Dec. 29, 1920.

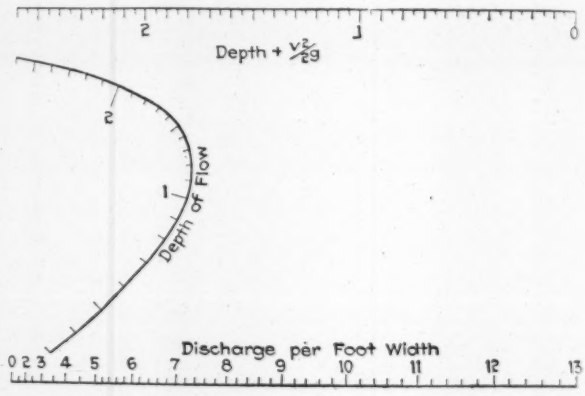
Another Nomogram for Cubic Equations

Sir—Mr. Okabe's nomogram for the solution of cubic equations (*Engineering News-Record*, June 24, 1920, p. 1249) is interesting, but complicated to use. A nomogram with one curved support can be made to give the solution by direct reading. An example is given for the solution of a hydraulic problem. In the formula involved the coefficient of x is zero, but when that of x^2 instead is zero the nomogram is similar in form.

The full analytic method of constructing these nomograms is given in Chap. VIII of Prof. John B. Peddle's "The Construction of Graphs and Charts" and also on p. 187 of Prof. Ocagne's work on nomograms; p. 335 of the latter even gives a nomogram for solution of the full cubic equation containing all terms.

Graphic methods, as usual, afford some short cuts. So, in the present example, when there is no discharge $v = 0$, and each point of the scale for "depth of flow" will lie on the line connecting the zero point of the discharge scale to an equal reading on the full-depth scale.

It is worth while to draw such a nomogram only for problems that occur frequently. For general and casual use the writer has devised means of solving both quadratic and cubic equations on the slide rule.



NOMOGRAM FOR SOLVING CUBIC EQUATIONS

India, Oct. 25, 1920. CUSEC.

The Writing of Engineering Reports

Sir—Your correspondent in your issue of Dec. 23, p. 1248, seems to deplore the absence of instruction in the "King's English" in our technical schools. He seems to forget that the technical school is not a grammar school and that a thorough knowledge of English is a prerequisite for the successful study of an engineering course.

The lack of fluent expression in speaking and of logical arrangement in writing is painfully evident in the efforts of many engineers. The writing of reports and the making of oral presentation should be included in the technical course, but they should be incident to the subject pursued rather than a drill in English.

The use of clear and forceful English is the work of the preparatory school and to a great extent should be acquired before the technical course is undertaken.

H. C. HODGKINS,
Syracuse, N. Y., Jan. 5.

NEWS OF THE WEEK

New York, January 13, 1921

Enlarged Appropriation for Reclamation Service

(*Washington Correspondence*)

Approval by the House of Representatives of the Sundry Civil bill carrying $20,277,000 for the Reclamation Service practically insures that amount for the work of the Service when the bill becomes a law. The bill still is to be considered by the Senate, but no reduction of the appropriation in that body is likely. By making available this large appropriation, a decided expansion of operation can be undertaken by the Reclamation Service. It will admit of nearly three times as much construction as is being carried on during the present fiscal year. The House made only minor changes in the bill as it was reported from the committee, among which was the elimination of the authority to continue the publication of the *Reclamation Record*.

The appropriation of $1,570,000 for the Boise project in Idaho makes it possible to construct a new unit on that project. An appropriation of $300,000 for the King Hill project in Idaho will make it possible to finish the work there. The item of $1,735,000 for the Minidoka project, Idaho, allows for the beginning of that work on an extensive scale. The appropriation of $1,017,000 for the Milk River project in Montana probably will allow for the commencement of work on a new reservoir. The same is true of the Sun River project in Montana, to which $687,000 is allotted. The item of $2,115,000 for the North Platte project in Nebraska and Wyoming will permit the inauguration of the important work of the Fort Laramie unit. The Newlands project, Nevada, is allotted $1,488,000 which will make possible the construction of a new reservoir. The appropriation of $1,213,000 for the Klamath project in Oregon and California will permit a very considerable extension of that project. A new reservoir at Tieton is the probable result of making available $2,100,000 for the Yakima project, Washington. The Riverton project, Wyoming, for which a small amount was allowed last year with which to start the work, now receives an appropriation of $850,000, which will permit of operations on a much larger scale. The Shoshone project in Wyoming is allotted $1,784,000, thus making possible the new Willwood unit. The only new project authorized in the Sundry Civil bill is the Deschutes project in Oregon, for which $400,000 is allowed to begin construction. The increased appropriations are derived from funds released by the General Mineral Leas-

Favors Another Panama Canal

According to newspaper reports, Secretary of War Baker favors the construction of a second Isthmian canal, either paralleling the Panama Canal or cutting through Nicaragua. He said he was opposed to the proposal to make the Panama Canal a sea-level canal.

It is stated that some of the authorities consider that traffic through the canal has reached such proportions as to make it only proper foresight to begin to think of an extension or duplication of its facilities.

Tentative Program for Road Builders' Convention

The tentative program for the eighteenth annual convention of the American Road Builders Association, to be held at the Coliseum, Chicago, Feb. 9-12, has been announced. Some of the discussions on the program, and the speakers, follow:

"Our National Road Problems," Thomas H. MacDonald, chief, Bureau of Public Roads; "Relation of the Highway and Motor-Transport Movement to Education," R. D. Chapin, president, Hudson Motor Co.; "The Highway's Part in the Development of Efficient Transportation," C. W. Reid, manager, transportation bureau, Federal Highway Council; "Subgrades," H. G. Shirley, secretary, Federal Highway Council; "Importance of Drainage in Road Construction," F. M. Eno, professor of engineering, Ohio State University; "Highway Research and What the Results Indicate," A. T. Goldbeck, engineer of tests, Bureau of Public Roads; "Highway Finance," H. C. Sylvester, vice-president, National City Co., New York; and, "Relation Between Engineers and General Contractors," D. A. Garber, Associated General Contractors of America.

One of the features of the sessions will be a mass meeting and smoker to be addressed by Governor Small of Illinois, and Mayor Thompson, of Chicago. A musical program has also been arranged.

Propose Bridge Over Ohio River at Evansville

Bills have been prepared for introduction in the Indiana and Kentucky legislatures authorizing the construction of a bridge across the Ohio River at or near Evansville, Ind. The projectors propose that each state shall contribute $1,500,000 and that the national government shall also share in the cost. E. H. Hyman, secretary of the Chamber of Commerce of Evansville, is one of the sponsors.

Public Works Association Makes Final Report

Under date of Dec. 30, 1920, C. T. Chenery, secretary of the National Public Works Department Association, made what is in effect a final report to the executive committee of the association. The practical termination of the work is indicated in the following paragraph: "The Federated American Engineering Societies by a vote of its council on Dec. 17, 1920, decided to carry on the work undertaken by its predecessor, Engineering Council, and to include therein the work of the National Public Works Department Association." The association ends its career in debt $14,902.18 to Engineering Council, which advanced $25,000 out of funds provided by J. Parke Channing. The amount on hand at present is $430.

The final report of Mr. Chenery recites in detail the history of the association and gives credit to the various individuals who aided it in its work. He also describes the progress of the campaign for a public works department, ending with the signing by the President of the Smoot-Reavis joint resolution providing that a committee made up of three Senators and three Representatives be charged with the duty of making a survey of the administrative branch of the government for the purpose of working out a general reorganization program. It notes the bill introduced by Senator McCormick, of Illinois, which provides for the reorganization of the executive branch of the government, and in particular for the creation of a department of public works substantially along the lines as laid down by the Jones-Reavis bill. This McCormick bill bears the number S. 4542.

Mr. Chenery's report has a final paragraph on the present situation regarding a public works department: "Either Senator McCormick's bill or the Jones-Reavis bill to create a department of public works is acceptable to this association. The former is perhaps the better of the two. It was drawn more than a year after the introduction of the latter and the framer had the benefit of the observations and of the criticisms which had been made. The most serious objection to the Jones-Reavis bill in the minds of many men is that it transfers various activities of education and public health to the Department of Labor. The McCormick reorganization bill handles this situation by setting up a separate department of public welfare and transferring these services to that. The McCormick bill does not include in the department of public

works the Coast & Geodetic Survey or the Bureau of Standards. It does, however, include the Federal Power Commission, the War Minerals Relief Commission, and the Inland Waterway Service which were not included in the Jones-Reavis bill. Either bill will give a well rounded department and one satisfactory to the engineering profession. This is the legislative situation as it exists at the close of the year 1920."

Would Consolidate N. Y. State Engineering Offices

The message of Governor Miller of New York to the Legislature recommends the consolidation of a number of departments. Among them is one that is of interest to the engineering profession, the consolidation of the State Engineer, Superintendent of Public Works and the Commissioner of Highways.

This consolidation will require three years, as the Superintendent of Public Works is a constitutional office and cannot be consolidated before submitting a constitutional amendment to the people to be voted upon. The office of the Superintendent of Public Works was created in 1878, and provides compensation of $8,000 annually. The duties of the Superintendent are to execute all laws relating to the repair and navigation of the canals. The Department of Highways was reorganized in 1913 with a single head as Commissioner, for a term of five years at an annual salary of $10,000, to have general supervision of all highways and bridges of the state.

The Governor believes that the duties of these departments should be performed by the State Engineer, both from an economical and efficient view, inasmuch as the duties of the State Engineer are waning with the completion of the Barge Canal.

Growth of New York Rapid Transit Shown in Annual Report

An increase of 284,830,770 passengers carried during the year ending June 30, 1920, over the preceding year is indicated in the annual report of the Public Service Commission, First District, New York, submitted to the legislature Jan. 10, the principal feature of which is the rapid growth of traffic on the rapid transit lines of New York City.

On the Interborough Subway traffic increased from 461,147,058 in 1919 to 586,098,633 in 1920, or an increase of 27.1 per cent. Passengers carried by the Brooklyn Rapid Transit System increased from 308,879,791 in 1919 to 376,782,635 in 1920, an increase of 21.98 per cent. Traffic of the elevated lines increased 15.99 per cent and the Hudson and Manhattan Tubes 7.21 per cent. Traffic on surface lines in Manhaatan shows a decrease of 5.71 per cent and in Richmond 4.96 per cent. In Brooklyn and the Bronx travel on the surface lines increased.

Army Engineers Approve Potomac River Project

Acting under the order included in the Federal Water Power Bill passed last June, the Chief of Engineers, U. S. Army, has forwarded to Congress a preliminary report on the possibilities of developing the water power in the Great Falls of the Potomac, 18 miles above Washington, D. C. This investigation was in charge of Major M. C. Tyler, Corps of Engineers, U. S. A., but at the time Congress convened Major Tyler was ill and could not prepare his complete report. The Chief of Engineers, Major-Gen. Beach, therefore presented the report in preliminary form until Major Tyler's report was available.

The preliminary letter states that the estimates show that it is probable that the Potomac River will be more advantageous as a source of additonal water supply, which was also a part of the investigation, than the Patuxent. The conclusion has been reached that a power development of from 45,000 to 50,000 kw. is possible and that its cost will be such as to permit the delivery of intermittent power at a total cost, including all proper overhead and transmission charges, of about 5 mills per horsepower at substations in the city of Washington at a voltage of about 6,600. This estimate includes the cost of the high tension transmission line at three substations. The storage possibilities are found to be not very favorable unless an ultimate development of a total head of about 200 ft. is decided upon as desirable, thereby permitting the storage to be used twice, once in each stage of the development.

Work Started on Sacramento Water Filtration Project

Construction started Dec. 31 on the first or water-supply portion of the filtration project at Sacramento, Cal., the cost-plus contract for which is described on p. 77 of this issue. The work now under way includes the construction of (1) a pumping station 75 x 128 ft. in plan, housing both low-lift and high-lift motor-driven centrifugal pumps, having a combined capacity of 170,000 gal. per day. The pit in this station will be 75 ft. in diameter and 58 ft. deep, 38 ft. of the depth being below ground-water level; (2) a pair 30-in. steel pressure mains leading from the pumping station to the city's distributing system, 3,900 ft. distant; (3) a concrete structure in the Sacramento River serving as an intake tower which is to be 20 x 36 ft. in plan and 97 ft. high, with 64 ft. above the bottom of the river; (4) a pair of 5-ft. concrete intake conduits, 1,044 ft. long, leading from the intake tower to the pumping station's pit. These conduits are to be laid in open trench about 35 ft. below ground surface. Of this depth, 18 to 20 ft. is below the ground-water plane.

Because the equipment in the old pumping station, which is now serving the city, is reported to be of inadequate capacity and in a bad state of repair, this new work is being rushed to completion so that water may be delivered through it as soon as possible. Contract for the second or filtration portion of the new water-supply project is to be awarded next summer. The entire cost of the system will be approximately $2,500,000, of which the present work is to cost $1,035,000 and the remainder is to be used for the filtration contract not yet awarded.

The contractor for the work described is the Coast Construction Co., and the work is under the supervision of Bayly Hipkins, president. C. G. Gillespie is resident engineer on the work and C. G. Hyde is consulting engineer.

Detroit Postpones Action on Bids for Belle Isle Bridge

Action on the second set of bids for the construction of the Belle Isle bridge at Detroit was postponed indefinitely by the city council on Dec. 28. All of the first bids opened in November were rejected, as reported in these columns Nov. 18, 1920, p. 1015. Though Mayor Couzens urged that the contract for the substructure be let to the low bidder, a local contractor, the work was readvertised. Bids on this second letting were opened Dec. 17.

Councilmen who voted against letting contracts at the present time believe that a new bond issue should be voted on before any further contracts are awarded, inasmuch as the original bond issue authorized by the voters in 1919 provided for a bridge to cost $3,000,000, and the bids indicate that the bridge as planned probably could not be built for less than $4,500,000.

The council rejected all bids, but this action was vetoed by the mayor. The council thereupon voted to reconsider its action, and later postponed indefinitely any further consideration, which makes the situation similar to that existing before the mayor's veto. Mayor Couzens takes the attitude that it is the wish of the people that construction work on the bridge be started immediately instead of waiting until further bonds could be voted at the April election, which postponement would result in a year's delay in the completion of the bridge. He also has stated that the council's action in readvertising for bids when it was evident that the bridge could not be built within the $3,000,000 limit authorized, and then refusing to let the contracts, will discourage large contracting firms from bidding on this and other Detroit jobs and will deprive the city of the benefits derived from competitive bidding.

A communication has been addressed to the mayor by the Detroit Building Trades Council commending his action in the matter in advocating that immediate work be started. It is stated in the letter that all public projects should be carried on where possible to relieve

the conditions resulting from present unemployment.

Suggestions that the work be proceeded with by the city in event contracts are not awarded at this time do not meet with the approval of the head of the Department of Public Works, as that department is not provided with the necessary equipment to do the type of work involved.

Further consideration of the bids is expected, since the council's action temporarily prevents the return of checks submitted by the contractors with their bids. Of the eleven contractors who bid upon various sections of the work two contracting firms, the Gillespie Contracting Co., of New York, and the Keystone State Construction Co., of Philadelphia, bid upon the entire job. Esselstyn, Murphy & Hanford are the engineers in charge of the bridge for the city.

San Diego-Arizona Railroad Again in Service

Service on the San Diego and Arizona Railroad, which connects San Diego, Cal., with the Imperial Valley, was resumed on Thanksgiving Day. Construction on this road was completed about a year ago but after six months of operation a very extensive rock slide occurred in Carriso Gorge which tore out a tunnel and so effectively blocked the line that it has taken almost six months to clear the right-of-way again.

Highway Transport and Engineering Courses Offered

Short courses in highway transport and engineering are offered this month at Purdue University and the University of Michigan. At Michigan the courses extend from Jan. 10 to March 25 and comprise the subjects: Earth, sand, clay, gravel and broken stone roads; bituminous surfaces and bituminous pavements; the mechanism, operation and maintenance of motor trucks, tractors and trailers; brick, cement, concrete, stone block and wood block pavement; highway engineering, financing, administration and organization. The seventh annual Michigan conference on highway engineering and highway transport is held Feb. 21-25.

The Seventh Annual Road School at Purdue will be held Jan. 18-20, and comprises lectures and practical demonstrations.

A. R. A. Elects Officers

At the annual meeting of the Board of Directors of the American Railway Association in New York City, Jan. 6, Daniel Willard, president, Baltimore & Ohio R.R., was elected chairman of the board. Other officers are: President, R. H. Aishton; vice-president, W. G. Besler, president, Central R.R. of New Jersey, and Hale Holden, president, Chicago, Burlington & Quincy Ry., and general secretary and treasurer, J. E. Fairbanks.

Ontario Engineers Taking Steps for Registration

Steps were taken to further an engineers' registration law for the province of Ontario at the meeting held in Ottawa, Jan. 5, attended by members of the combined engineering organizations of Ontario and presided over by Charles Camsell, Deputy Minister of Mines. Engineers' registration acts have been passed in every province of the Dominion except Ontario, Saskatchewan and Prince Edward Island, and it is estimated that most of the practicing professional engineers of the Dominion are resident in Ontario, many being employed by the Dominion of Ontario government, and by the Ontario Hydro-Electric Power Commission. The meeting was addressed by Willis Chipman, consulting engineer, Toronto, and J. B. Challies, director, Dominion Water Power's Branch, who have been acting on the provincial committee of engineers formed to draft a registration law for Ontario.

Engineers Approve Licensing Statute

The Memphis, Nashville and Chattanooga chapters of the American Association of Engineers have approved a tentative bill that will be presented to the Tennessee legislature to convene in January providing for the licensing of civil engineers, architects and surveyors. The committee appointed to draft the bill follows: C. H. Olmstead, engineer, Nashville; J. G. Gaut, engineer, Chattanooga; C. E. Shearer, architect, of Memphis; W. M. Beer, engineer, Knoxville; and Henry Hibbs, architect, of Nashville.

Will Hold Hydro-Electric Symposium

On Friday, Jan. 21, a symposium on hydro-electric power and distribution is to be held under the auspices of the Engineers' Club of Philadelphia and the Philadelphia sections of the American Society of Civil Engineers, the American Institute of Electrical Engineers and the American Society of Mechanical Engineers. Two sessions are to be held, one at 2:45 p.m. and the other at 8 p.m., both at the Manufacturers' Club, and an informal dinner will be held at 6:30 p.m. at the Bellevue-Stratford Hotel. The program of the meeting includes the following papers:

"The Modern Hydraulic Turbine," by Frank H. Rogers, hydraulic engineer, I. P. Morris Dept., the William Cramp & Sons Ship and Engine Building Co.; "The Application of a New Method of Water Measurement in the Efficiency Tests of the 37,500-Hp. Turbines of the Niagara Falls Power Company," by Norman R. Gibson, hydraulic engineer, the Niagara Falls Power Co., Niagara Falls, N. Y.; "Surges in Conduits and Other Hydraulic Problems," by Raymond D. Johnson, consulting engineer, New York City; "The Present Trend of Hydraulic Turbine Development," by Lewis F. Moody, consulting engineer, I. P. Morris Dept., the William Cramp & Sons Ship and Engine Building Co.; "Niagara Falls Power Development and Its Products in Philadelphia" (illustrated), by John L. Harper, vice-president and chief engineer, the Niagara Falls Power Co., Niagara Falls, N. Y., and "Electrical Features of Hydro-electric Power," by David B. Rushmore, chief engineer, Power and Mining Department, General Electric Co., Schenectady, N. Y.

File on Huge Power Project on Colorado River

The Federal Power Commission has acknowledged receipt of an application filed by the Southern California Edison Co. of Los Angeles, Cal., for developing 2,500,000 hp. on the Colorado River. The plan is for a dam at Lees Ferry, about 800 miles from the mouth of the river, at a point where a 500-ft. dam would back up the water for 200 miles and provide a storage of 40,000,000 acre-ft. This site, which is above the Boulder Cañon site, and also above the Grand Cañon, will not affect the Grand Cañon or other sites within the National Park. A feature of the project is the control of flood waters and an increase of the area below that could be irrigated by Colorado River water from 750,000 acres to 3,000,000 acres.

Increase in New York Building Plans During 1920

According to the annual report of the Manhattan, New York City, Bureau of Buildings for the year 1920, compiled by Superintendent R. P. Miller, plans were filed for 783 new buildings costing a total of $96,199,860, as against 370 buildings costing a total of $72,283,061 during 1919. The most active month of the year was July, when plans were filed for 141 new buildings. Classification and cost of construction is as follows:

Number	Class	Cost
22	Dwellings	$1,503,500
22	Tenement houses	13,565,000
48	Stores and lofts	6,836,250
81	Office buildings	44,668,400
23	Manufactories and workshops	500,000
1	Church	60,000
14	Municipal buildings	5,140,000
8	Hospitals	5,350,000
482	Garages	6,348,318
51	Other structures	403,892

Of these new buildings for which plans were filed the construction of 300 was commenced and 253 were completed.

Highway Labor in New Jersey to Suffer Wage Reduction

Beginning Jan. 16 wages of 500 to 600 men employed in the maintenance division of the New Jersey State Highway Department will be reduced ten cents per hour. This action was taken by the commission upon the recommendation of the chief engineer,

Thomas J. Wasser. The present wages of laborers range between 45 cents and 60 cents per hour. The reduction, it is estimated, will represent a saving of $200 per day.

Chicago Bricklayers Demand Pay Increases for 1921

Michael J. Faherty, president of the board of local improvements, Chicago, recently received notice from union bricklayers that an increase in wages was to be demanded for 1921, says recent press reports. Ordinary bricklayers ask $10 a day with time and a half for overtime and double time for Saturday afternoons and holidays. Other demands are:

Examining mason contractors, $275 a month; general construction foremen, $275; sewer foremen, $310; sewer repair foremen, $310; bricklayers in charge of gangs, $285; sewer inspectors, $275; mason inspectors, $235; junction setters, $235; brick and concrete foremen, $275; and foremen of brickwork in water-pipe extension work, $275.

Residential Construction Decline Marked in 1920

According to figures compiled by the F. W. Dodge Co., New York, the most conspicuous feature in the decline in building construction during 1920 was in residential building. In 1919 this class of construction represented 33 per cent of the total and in 1920 but 22 per cent. The amount of residential floor space contracted for fell off from 240,000,000 sq.ft. in 1919 to 140,000,000 in 1920.

Southern Pine Orders Lowest in Closing Week of 1920

For the week closing Dec. 31, 1920, 125 mills, members of the Southern Pine Association, reported orders aggregating approximately 33,000,000 ft. b.m., the lowest figure that was reported by the barometer of the association for the last quarter of 1920. The actual production of these mills was 74 per cent below normal, the shipments 57 per cent below normal production and the orders 62 per cent below normal production. The normal production of the mills is 86,000,000 ft. b.m.

Nominations for A. G. C. Offices Are Reported

The nominating committee of the Associated General Contractors of America has proposed the following candidates for office:

President, W. O. Winston, of Winston Bros. Co., Minneapolis; vice-presidents, to serve until 1924, F. L. Cranford, of F. L. Cranford, Inc., Brooklyn, N. Y.; Arthur Bent (to fill vacancy), of Bent Bros., Los Angeles, Cal.; treasurer, to serve until 1922, Lee Pascal, of Wise Granite Construction Co., Richmond, Va.; directors, to serve until 1924, Benjamin H. Hardaway, of Hardaway Construction Co., Columbus, Ga.; Noble Foster Hoggson, of Hoggson Bros., New York City; George C. Mason, of Hurley-Mason Co., Portland, Ore.; W. A. Starrett, of George A. Fuller Co., New York City; directors, to serve until 1923 (to fill vacancies), Richard McCarthy, New Orleans, La.; G. O. Muhlfeld, of Stone & Webster, Boston; John R. Wiggins, of John R. Wiggins Co., Philadelphia.

Pan American Labor Conference Opens in Mexico City

Samuel Gompers, president of the American Federation of Labor, with fourteen other representatives of American labor, are in Mexico City, where the third Pan-American Federation of Labor Conference is being held. Creation of harmonious relations between labor in the United States, Mexico and Central and South America is the object of the conference.

Trade Associations Advised to Correct Codes of Practice

In a circular letter issued Jan. 10 by the Building Trades Employers' Association of New York City trade associations, members of the employers' association, are requested to examine carefully their constitutions and by-laws and eliminate therefrom any provisions that, in the light of the recent investigation made by the Lockwood committee on housing, might render such trade associations subject to criticism. If these trade associations have adopted codes of practice they are requested to discontinue them unless it is felt the associations are acting absolutely within legal rights. If the latter is the case the employers' association asks that codes of practice be presented by representatives on the board of governors at the next regular meeting of the board.

The letter from the employers' association also maintains that it has the right to make agreements with labor unions, and "until such time as another method is found by which a more amicable relation with labor can be established the Building Trades Employers' Association will continue to deal with unions as it has in the past, always endeavoring to strengthen its power and influence for the promotion of the building industry and the protection of the interests of owners and investors, not only in the city of New York but throughout the entire country."

The employers' association points out that there is nothing in either the constitution or by-laws of the association, or orders of the board of governors, that is contrary to law or in any way conflicts with public policy or the best interest of society, citing its constitution, which provides: "Nor shall there be any action on the part of this association to control or in any way deal with prices or restrict competition."

The Building Trades Employers' Association believes that the building industry is confronted with more serious problems than it has faced since 1903.

Sand Dealers Plead Not Guilty to Trust Charge

Five of the sand dealers of the metropolitan district of New York who were recently indicted by the Federal Grand Jury in violation of the Sherman anti-trust law appeared Jan. before Judge A. N. Hand, of the Federal District Court, and entered pleas of not guilty. Bail of $5,000 was fixed in each case, and nine days were allowed the defendants in which to file demurrers or take other action.

Broader Powers Proposed for Lockwood Committee

The Lockwood Legislative Committee on Housing, which has been investigating housing conditions in New York City, is to be invested with broader powers if the plans of the committee's counsel prevail. There has been drafted a resolution, now in the hands of the New York Legislature, empowering the committee to grant immunity from prosecution to certain witnesses, and to inquire into the management of insurance and banking institutions.

Special Federal Counsel Provided for Building Exposé Cases

The Attorney-General of the United States has appointed William Rand and Isador J. Kresel, New York City attorneys, as special assistants to the Attorney-General. They will take charge of all cases under the Federal statutes, civil or criminal, developing from building trade investigations.

Annual Meeting of U. S. Chamber To Be Held April 27-29

Announcement was made Jan. 11 that the ninth annual meeting of the U. S. Chamber of Commerce will be held at Atlantic City, N. J., April 27-29.

Housing Problems to Feature U. S. Chamber's Council Conference

Interchange of information and a general discussion of housing conditions will mark the conference in Washington of the national council of the United States Chamber of Commerce, Jan. 27-28. The tentative program announced by the chamber includes discussions on all phrases of national as well as sectional housing problems.

Civil Service Examinations United States

For the United States civil service examination listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Junior Engineer and Deck Officer, U. S. Coast and Geodetic Survey, $2,000 a year increased to $2,240 after one month of satisfactory service. Examinations to be held Feb. 9-10 and April 13-14, 1921.

State of Idaho

For application blanks apply to Bureau of License, Boise, Idaho.

Surveyor. Examination to be held March 1, 1921.

Civil Engineer. Examination to be held March 8, 1921.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City, Jan. 19-20, 1921.

AMERICAN CONCRETE INSTITUTE, Detroit; Chicago, Feb. 14-16.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

AMERICAN ROAD BUILDERS' ASSOCIATION, New York City; New Orleans, Feb. 9-12.

The Michigan Engineering Society will hold its annual meeting Jan. 25-27 at the Wayne County Building, Detroit. The secretary is C. B. Huff, 6017 Grand River Ave., Detroit, Mich.

The Indiana Engineering Society will hold its forty-first annual meeting at the Claypool Hotel, Indianapolis, Jan. 27 and 28. Several of the sessions will be joint meetings with local sections of other organizations.

The Engineers' Club of Little Rock, Ark., at its noonday meeting Dec. 18 decided to recommend to the General Assembly a bill providing that no person, firm or corporation will be allowed to execute any job of land surveying, engineering or architectural work in the state except under a certificate from an engineering board showing qualification.

The Michigan Engineering Society will hold its annual meeting Jan. 25, 26, 27 at Detroit. The speakers for Jan. 25 are Hon. John Lodge, Hon. A. J. Groesbeck, Charles Wood and Dean George W. Bissell. For Jan. 26 the following topics and speakers are announced for the morning session: Major Theo. Leisen on "Detroit's Filtration Plant," H. H. Esselstyn on the "Bell Isle Bridge" and John Reid on "Grade Separation in Detroit." The program for the afternoon consists of inspection of the Belle Isle Bridge, the water-works pumping station and sewers. The evening meeting will be addressed by Prof. Arthur Blanchard. There will be a discussion on highways by Frank F. Rogers, State Highway Commissioner. The Jan. 27 morning session will be addressed by L. K. Sherman, R. C. Bailey, Dr. Vaughn, Health Commissioner, Detroit, and Alexander Dow. The business session will be held in the afternoon.

The San Francisco Section, Am. Soc. C. E., held its annual meeting on Dec. 21. The following officers were elected for the ensuing year: President, F. R. Muhs, vice-president San Francisco Bridge Company; vice-president, Thomas H. Means, irrigation engineer; secretary-treasurer, Nathan A. Bowers, Pacific Coast editor, *Engineering News-Record*. There were present about one hundred and thirty members and guests who listened to a symposium on hydro-electric development consisting of three illustrated, twenty-minute talks as follows: "Economic Aspects of the Present situation," Wigginton E. Creed, president, Pacific Gas & Electric Co.; "Modern Hydraulic Equipment," E. C. Hutchinson, chief engineer, Pelton Water Wheel Co.; "Successful Methods On Rush Construction," Rex C. Starr, construction engineer, San Joaquin Light & Power Co.

The Illinois Drainage and Rivers Improvement Association will hold its annual meeting Jan. 18-19 at Springfield, Ill.; secretary, G. W. Pickels, Urbana, Ill.

The Albany Society of Civil Engineers at its meeting Dec. 21 elected the following officers: President, Alexander R. McKim; vice-president, Walter H. Mansfield; second vice-president, C. H. Wood; third vice-president, Joseph A. Murray, Jr.; secretary-treasurer, John W. Henry; librarian, Carl O. Ullrich.

PERSONAL NOTES

ARNOLD B. MACSTAY has resigned as street cleaning commissioner, New York City, and has been appointed deputy commissioner of public welfare.

GEORGE E. TEBBETTS, formerly with the construction and engineering division, Stone & Webster, Boston, Mass., has resigned to become associated with the Roberts & Schaeffer Co., engineers and contractors, Chicago.

LEE RILEY, consulting engineer, Leavenworth & Fort Leavenworth Water Co., Leavenworth, Kan., will continue in charge of the operation of the works which are to be taken over by the city early in 1921 and operated under the supervision of the Commissioner of Water and Street Lighting.

E. M. ARNOLD, recently engineer, Boone County, Ky., has accepted a position as assistant division engineer, Second District, State Highway Department of Georgia.

LLEWELLYN N. EDWARDS has resigned as senior highway bridge engineer, Bureau of Public Roads, to become bridge engineer for the Maine Highway Commission, Augusta, Me.

OREN E. PARKS, formerly town engineer, has been appointed superintendent of highways, sewers and water-works of the Department of Public Works for Westfield, Mass., recently incorporated as a city.

JOHN H. HEINTZ, formerly assistant engineer of the Newport Levee District, Ark., has engaged in the stationary and office supply business in Oklahoma City, Okla.

B. B. SHAPIRO, for the past five years with the architectural firm of Holabird & Roche, Chicago, most recently as chief engineer, has engaged in private practice in consulting and designing structural engineering with offices at Chicago. During his connection with Holabird & Roche he was designing engineer for many office buildings and industrial enterprises in Chicago.

SAMUEL J. HUMES, for four years engineer of King County, Wash., will, upon expiration of his term, become a member of the engineering firm of Parker-Gould Co., Seattle, Wash.

D. O. LEWIS, formerly district engineer, Vancouver Island division, Canadian National Rys., has been appointed engineer maintenance of way, Canadian Northern Ry. east of the Great Lakes, with headquarters at Toronto.

J. H. REDDING, assistant superintendent, Pittsburgh division, Pennsylvania R.R., has been appointed superintendent, Wheeling Terminal division.

HARRY THOUROT, recently connected with the Hudson County Engineer's office, has been appointed town engineer, Union Hill, N. J.

L. P. O. EXLEY, office engineer, Mobile & Ohio R.R. at St. Louis, Mo., has been appointed office engineer, Gulf, Mobile & Northern R.R. at Mobile, Ala.

L. B. DUTROW has resigned as chief engineer, Atlantic Coast Realty Co., to enter private practice in engineering and land surveying with offices in the Roper Building, Petersburg, Va.

E. W. SYLVESTER has resigned as superintendent of public works and city engineer of Poughkeepsie, N. Y., to enter the Pennsylvania State Highway Department.

GEORGE F. WHITMORE, engineer in charge of jetty work at Eureka, Cal., has been ordered to San Francisco by Colonel Herbert Deakyne, district and divisional engineer, to act as his assistant on river and harbor works.

WILLIAM H. PENFIELD, engineer of track maintenance, Chicago, Milwaukee & St. Paul Ry. since 1913, has been appointed engineer maintenance of way, with headquarters at Chicago.

PHILIP L. PRATLEY, mentioned in these columns last week, is in charge of the bridge section of the Montreal office, Department of Railways and Canals, Grand Trunk Arbitration. R. A. C. Henry is the department engineer in charge of the project.

H. L. THACKWELL, formerly hydraulic engineer, Anaconda Copper Mining Co., on the Andes project in Chile, S. A., has accepted the position of hy-

draulic engineer for the Royal D. Salisbury Co. of New York and Denver.

DORSEY W. HYDE, JR. has left the transportation engineering division, Packard Motor Car Co., to become assistant manager of the recently created Civic Development Department, Chamber of Commerce of the United States, Mills Building, Washington, D. C., of which John Ihlder is manager.

J. O. BOAKER has resigned as engineer in the timber and land department, Southern Pine Lumber Co., to become city manager of Lufkin, Texas.

F. LAVIS will resume his independent practice as consulting engineer at 120 Broadway, New York, specializing in transportation developments, especially in those relating to foreign countries. He has been retained by the American International Corporation, with which he has been associated since its inception.

GEORGE W. CUTTING, JR., recently engineer, production department, Atlantic Corporation, constructors of steel cargo ships, Portsmouth, N. H., has resumed private practice at 10 Post Office Square, Boston, specializing in property development, landscape engineering, drainage, sewerage, road location, surveys, investigations and reports, superintendence of construction.

F. W. AUSTIN has been appointed city engineer of Chanute, Kan.

WILLIAM T. FIELD, consulting engineer, Watertown, N. Y., has opened an office at 296 Broadway, New York City, and will specialize in industrial, hydraulic and municipal engineering work.

G. H. PALMES, Cimarron, N. M., has been appointed superintendent of the Cimarron & Northwestern Ry.

MANUEL C. CUTLER, for four years bridge engineer, has been appointed superintendent, Bridges and Public Buildings Department of the Department of Public Works, Milwaukee, Wis.

JOHN KLORER has been appointed city engineer of New Orleans, La.

GEORGE W. BOSCHKE has been appointed assistant chief engineer for Lines West of Ogden, El Paso and Portland, with the Southern Pacific Co., Pacific System.

JOHN N. CARLISLE, former state highway commissioner, New York, has been elected president of the Northern New York Utilities, Inc.

COLONEL GLENN S. SMITH has secured his discharge from the army and has resumed his position with the U. S. Geological Survey as topographic engineer in charge of the West Indian surveys.

NORMAN J. HOWARD, bacteriologist in charge of the filtration plant of the city of Toronto, has resigned to become manager of the water-works department, General Supply Co. of Canada, Ltd., with headquarters in Ottawa.

W. E. SELBY has been appointed assistant engineer of Tarrant County, Texas.

COL. FREDERICK F. CLARKE has been apointed chief land surveyor for the Canadian National Railways and is organizing a land surveys department.

MAJOR PHILIP H. SHAFFER has been appointed engineer of Somerset County, Pa.

L. W. DUFFEE has resigned as chief engineer, Gulf, Mobile & Northern R.R., to enter general practice with office at Laurel, Miss.

CARL NYMAN, formerly resident engineer, State Road Commission, Utah, has resigned to enter private practice in general engineering in the coal fields of Carbon County, Utah, with headquarters at Castlegate.

OBITUARY

ROY BULLEN, civil and mining engineer, died Dec. 24 while on his yacht near Florida. He was born in Richmond, Utah, 1877. In 1903 he was inspector of steel concrete construction at Harvard Stadium. During 1904 he acted as assistant in the engineering department Massachusetts State Board o. Health, Boston; 1905, tutor in hydraulics, Harvaid University; June, 1905-1906, Engineering Aid, United States Reclamation Service, in charge of canal construction on Minidoka and Payette-Boise projects, Idaho. From 1906 to 1908 he conducted railroad location surveys and mine surveys at Salt Lake City, Utah, and later at Rosebud, Nev. He was later mine superintendent, White Alps Leasing Co., Rosebud, Nev. In 1909 he reentered private practice in civil and mining engineering, Salt Lake City. Later he was general agent, Grand Trunk Ry., Minneapolis, Minn.

J. E. KENNEDY, C. E., died at Owen Sound, Ont., Jan. 1. He was 68 years old and had been city engineer of Owen Sound and also of Vancouver, B. C.

ROBERT C. SATTLEY, valuation engineer, Chicago, Rock Island & Pacific Ry., died Dec. 31 at Oak Park, Ill. He was born in 1856 at Ferrisburg, Vt. and was graduated from the University of Vermont in 1879. From 1879 to 1884 he was with the Northern Pacific Ry., advancing from the position of rodman to that of assistant engineer. In 1884 he was assistant engineer, Oregon Pacific Ry. In 1885 he became assistant engineer on location and in charge of construction, Northern Pacific Ry. From 1885 to 1907 he was with the Chicago & Northwestern Ry. as assistant engineer, superintendent of bridges and buildings and division engineer. During the following year he served as assistant engineer for the State of Minnesota and later was locating engineer, Denver, Laramie & Northwestern Ry. in Colorado, and for the St. Louis & San Francisco R.R. in Texas. In July, 1909, he was appointed valuation engineer, Chicago, Rock Island & Pacific Ry. and continued in the employ of this company until his death.

BUSINESS NOTES

THE CHICAGO PNEUMATIC TOOL CO. announces the appointment of J. F. Huvane as Eastern manager of compressor and engine sales with headquarters in New York City. G. C. VandenBoom has been appointed Western manager, with headquarters in Chicago.

CHICAGO BRIDGE & IRON WORKS announce the opening of a new sales office in the Forsythe Building, Atlanta, Ga. Joseph L. Zeller, for several years with this company, will be in charge.

THE NATIONAL LIME ASSOCIATION, Washington, D. C., announces the appointment of Laurance E. Hart, C. E., as manager of the construction department and Dr. Major E. Holmes, manager of the chemical department. Mr. Hart's experience includes six years on the New York State Barge Canal. His most recent engagement was construction sales engineer with the Lakewood Engineering Co. Dr. Holmes was for nine years research engineer for the National Carbon Co., Cleveland, Ohio, during which time his experience extended to most of the departmental duties of a manufacturing plant.

THE TROJAN POWDER CO. has taken over and will conduct the entire business heretofore conducted by it and its associated companies, the Pennsylvania Trojan Powder Co., the California Trojan Powder Co., and the Trojan Chemical Co., Inc.

THE GOULDS MANUFACTURING CO., Seneca Falls, N. Y., manufacturer of pumps, announces the appointment of Edward S. Jenison as acting sales manager to succeed W. E. Dickey, who is retiring from business. For the past five years Mr. Jenison has been manager of the company's Philadelphia office.

THE CUTLER-HAMMER MFG. CO., Milwaukee, has opened a branch office in the Railway Exchange Building, St. Louis, Mo., which will be in charge of Harold Phillips, recently manager of the Chicago office.

A. J. WHIPPLE has been appointed general sales manager of the Republic Truck Sales Corporation of Alma, Mich.